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JANUARY, 1939

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NEW

SHELL

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OIL

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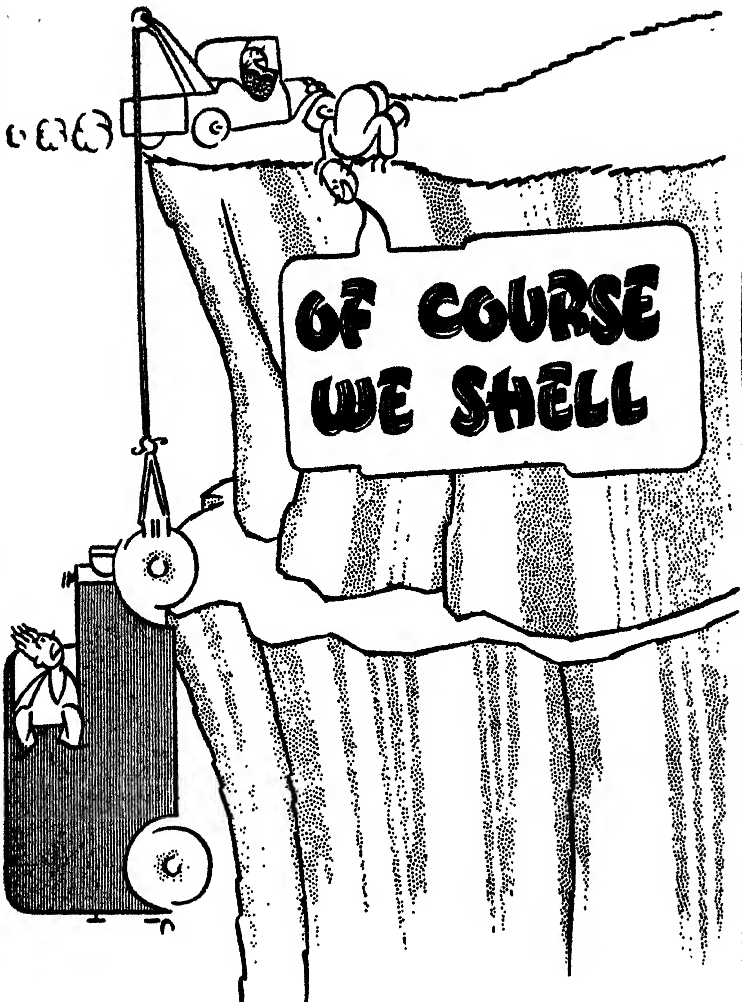
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NOTICE

The Agricultural Journal of S. Rhodesia

is issued by the Department of Agriculture, and can be obtained upon application to the Editor. The Annual Subscription, which must be paid in advance, is 5/-, and payment may be made by any means other than by stamps.

A 10/- note will cover the subscription for two years.

Persons residing outside Southern and Northern Rhodesia may become subscribers by paying 2/- in addition to the subscription, to cover postage.

If payment is made by a cheque drawn on a bank outside Rhodesia, commission must be added.

All cheques and postal notes must be made payable to the Secretary for Agriculture and Lands.

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DECEMBER, 1939.

THE RHODESIA

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(Assisted by the Staff of the Agricultural Department).

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VOL. XXXVI.] JANUARY, 1939. [No. 1

Editorial.

Contributions and correspondence regarding subjects affecting the farming industry of Southern Rhodesia are invited. All communications should be addressed to:—The Editor, Department of Agriculture, Salisbury. Correspondence regarding advertisements should be addressed:—The Art Printing Works, Ltd., Box 431, Salisbury.

We Wish all our Readers

A Happy and Prosperous

New Year

January Grass prevents September Poverty.—As a result of the splendid rains at the beginning of December there will be an abundance of grass in the country which ought to be made into hay before January is out. The younger the grass is when cut the more digestible it is and the higher the feeding value. The oftener young grass is cut the thicker the cover becomes and the longer it continues to grow. To get full value for the trouble of making hay it must be cut before it comes

into flower, and it is much better to get two or three cuttings of young nutritious hay than one of old hard grass which has little or no feeding value. One hundredth part of the young grass growing in this country in January, properly preserved, would carry ten million head of stock through the whole season without a single loss from poverty. If you can't make January hay while the sun shines cut grass in the rain and keep it as silage.

Supplement to Tobacco Diseases Handbook.—The handbook of Tobacco Diseases by Dr. J. C. F. Hopkins, Senior Plant Pathologist of this Department, was published in 1931. This has proved to be one of our most useful and popular publications not only with growers in this country but also in many parts of the world where tobacco is grown. It contains six coloured plates and 38 figures and is sold at four shillings per copy. During the seven years which have elapsed since this Handbook was published a good deal of new information has been obtained and several new diseases have been recorded. A supplement appears in this *Journal* with one coloured plate and 21 text figures which brings the Handbook up to date. A limited number of reprints will be available for those growers who wish to keep the supplement with the Handbook they already possess. Copies can be obtained from the Editor, P.O. Box 387, Salisbury, at a cost of 1s. each.

Wild Flowers on the Farm.—As mentioned in last month's *Journal*, we are starting a new series of articles in this issue dealing with the common trees and wild flowers which are commonly found on Rhodesian farms. Many farmers or members of their families, are interested in the plant life on the farm but find it difficult to make much progress because there is no book available to give the name or any information concerning even the commonest kinds. Unfortunately the scientific names have to be used, as in almost every case no popular name has yet been given to the flower. Some have native names, but these are often difficult to associate with the plant and vary from district to district. To make this series of articles a success it is absolutely essential that suggestions should be made by farmers as to what they wish

to know about and that specimens should be sent to the Director of Agriculture for his guidance in making the most popular selection. In many cases as possible it is particularly desired that appropriate common names should be suggested, as in this way it should be possible to decide upon suitable names which can become of general use throughout the country.

Wankie Game Reserve Closed till June 1st.—The Wankie Game Reserve is closed yearly from January 1st to May 31st. This past holiday season has been a record one in several respects. The number of visitors constitutes a record and it is anticipated that when the additional roads are completed and the Reserve becomes better known it will become one of the greatest attractions for tourist traffic in the country. As indicated in a recent *Journal*, every visitor on entering the Reserve is supplied with a form which gives a plan of the roads through the Reserve and visitors are requested to fill in all records of game seen on their visit and to leave the completed return with the Game Warden on leaving the Reserve.

According to the forms handed in over 8,000 head of game have been seen during the last six months. Lions proved the greatest attraction and elephant next. Giraffe and gemsbok were always popular. The Game Warden wishes to thank all visitors who recorded the game they saw and returned the forms to him at the end of their visit.

A New Wheat Rust in Kenya.—A fifth and new form of stem rust in wheat, known as K.5. has been recorded in Kenya Colony. A new breeding programme to combat this new form is already under way. Two new hybrids have shown resistances to the new form of rust, and one of them has already reached the bulking stage—over one hundred bags have been sown this year. Under normal conditions Sabanero showed resistance to this form of rust.

The appearance of further new forms of stem rust is, of course, a possibility, but the present Kenya hybrids have shown a marked resistance in other parts of the world to a large number of forms, and it is hoped that the increased resistance which it is expected to obtain from the new crosses

will also prove of value in the eventuality of further new forms of stem rust appearing.

The importation of seed wheat into Kenya is prohibited as a preventive measure against the introduction of other forms of rust and similar diseases. The only exception which is made is for small quantities for experimental purposes which can be treated before being grown.

Washing Dirty Eggs.—Experiments conducted at the Missouri Agricultural Experiment Station have at last overcome the problem of dirty eggs. When washed in the ordinary way the eggs could always be picked out because the "bloom" of the shell was removed in the process and washed eggs never kept so well in cold storage and always commanded a lower price. It has now been found that if washed in lye made from 1 oz. caustic soda to a gallon of water the eggs kept well in cold storage as did naturally clean eggs of similar quality. When sold they commanded a price equal to that received for the naturally clean, unwashed eggs.

Furthermore, experienced dealers in eggs could not detect the eggs which had been washed; and cooking tests after eight and ten months' storage showed that the dirty eggs which had been washed in lye water were of equal quality to the clean eggs stored at the same time.

Because of the caustic properties of the lye solution, rubber gloves should be used when washing the eggs, but the fact that soiled eggs can be treated in such a way as to reduce to a minimum losses due to their becoming dirty suggests a possible solution to this vexing problem of how to handle dirty eggs.

Zinc Sulphate as a Fertiliser for Wheat.—According to the *Pastoral Review*, a new line of research is being undertaken by the Department of Agriculture of Victoria to investigate the surprising results obtained from the application of very small dressings of zinc sulphate to wheat lands. The effect was first noticed by research officers of that Department when testing this chemical against the eelworm of wheat. It will be interesting to learn whether the effect is due to zinc deficiency in the soils or whether some other factor is involved. At Nhill the addition of 30 lb. zinc sulphate per acre has produced

spectacular increases in yield of from five to 9.4 bushels, and at Longerenong an increase of 2.1 bushels has been obtained. Zinc sulphate costs about £23 per ton, so a dressing of 30 lb. per acre would run to about 6s., which leaves a good margin for profit. Why the chemical increases the yield is not clear, and as the discovery is yet in its infancy, farmers are advised to be chary with its use outside trial areas. It has been demonstrated in the Victorian Wimmera that light applications cause the wheat to mature exceptionally early.

New York World's Fair.—Southern Rhodesia is being represented at the New York World's Fair which opens in April, 1939. As it will be neither practicable nor possible to send over a comprehensive exhibit of our primary products, it is hoped to be able to give a clear conception of the Colony's development by means of a series of photographic enlargements illustrating farming, mining, industry and all interesting features of the country. Will all those who have suitable *negatives* (if negatives are not available then good prints) which they are prepared to donate or loan for this purpose, please send them at the earliest possible moment to the *Director of Publicity, P.O. Box* 1187, *Salisbury?*

Particulars should accompany the negative or photograph, and, if desired, acknowledgement of the donor or lender will be made on the enlargement.

Some Cleanliness Reminders. — Tobacco growers are reminded that primings and unthrifty plants unlikely to produce leaf worth picking are a danger to the rest of the crop, and should be destroyed at once. Early disposal helps to prevent the spread from them of whitefly, aphis, leaf minor, and other pests besides certain diseases. Unwanted seed-beds should be dug over.

In the farm orchard damage by melon fly, fruit flies, and false codling moth can be avoided to a considerable extent by the regular and frequent collection and effective destruction of all fallen or stung fruit.

Weeds in all lands should be destroyed while they are young to prevent the breeding of insects that can attack the crops.

CLEANLINESS AIDS INSECT CONTROL.

Trees and Wild Flowers.

ON THE RHODESIAN FARM.

By Chas. K. Brain, M.A., D.Sc., Director of Agriculture.

PART I.

Our Tallest Members of the Lily Family (*Liliaceae*).—We have four members of this family with stems from ten to thirty feet high. Three are Dracaenas and the other is our common tree aloe.

The Dracaenas are all found growing wild on the Eastern Border, usually in the forests which occupy the mountain kloofs. The commonest species is *Dracaena fragrans*, Gawl., which has often been brought from its forest home and planted in gardens. The one illustrated (fig. 1) is on the roadside in Salisbury. The three species can be separated readily when the terminal branched heads of flowers (panicles) appear. The flowers are numerous and tubular. *D. fragrans* and *D. reflexa* have flowers about three-quarters of an inch long. Those of *fragans* are yellow or greenish yellow; those of *reflexa* white tinged with red. The flowers of the third species, *D. gazensis*, are about 2 inches long and are whitish in colour.

The only tall-stemmed aloe which is common in the country, often in the shade of trees on granite soils, is *Aloe excelsa*, Berger. The stem may reach 30 feet high, and the leaves, which form a dense rosette on top of the stem, are from three to six feet in length. The flowers, which appear from August to September, are in dense spikes (racemes) from a branched flower stem (panicle). The individual flowers are tubular and vary in colour from light orange to deep crimson. Fig. 2 shows a number of tree aloes growing on a stony hill near Gwelo.

Fig 1 - *Dracaena fragrans* Gawl growing in Salisbury

Fig 2.—*Aloe excelsa*, Berger, on stony hill near Gwelo

Fig 3 *Lasiosiphon Kraussii*, Mtn Salisbury Commonage

Fig 4

Two Members of the Thyme Family (*Thymelaeaceae*).—All the common representatives of this family found in this Colony, with the exception of two which are restricted to the Eastern Border, belong to the Genera Gnidia and Lasiosiphon. These are closely related but may be separated by the fact that in Gnidia the parts of the flower are in fours, while in Lasiosiphon they are in fives. Further, the leaves of Gnidia are generally very short and narrow and scattered up the stem much like a heath plant, and those of Lasiosiphon are broad and usually hairy. The flower heads are generally dense, with many flowers, and the individual flowers are tubular, the sepals being united into a long slender tube which has 4 (Gnidia) or 5 (Lasiosiphon) lobes. The petals are very short, or sometimes entirely absent. When present they alternate with the lobes of the sepals and are mounted on the tube. The stamens are usually entirely enclosed in the tube in Gnidia and half of them extend above the tube in Lasiosiphon.

Some of our species extend to South Africa and have long been used by natives for various purposes, while a number of the South African species have been proved to be poisonous to stock. It is probable that all species contain substances which cause a burning sensation in the mouth and which are dangerous irritants if swallowed in any quantity.

Thus *Lasiosiphon Burchellii*, Meisn., a woody shrub, with the leaves congregated towards the tips of the branches, which has been reported from the Gwelo district, is said to have been the cause of loss of stock frequently in the Vryburg area. When tested at Onderstepoort it caused the death of a sheep on the third day.

Lasiosiphon Kraussii, Meisn., which is very common in Mashonaland, on burnt ground in the early summer is also said to be exceedingly poisonous and rapidly fatal to stock. The Zulus use it as a snake bite remedy and a decoction of the leaves is used as a gargle for sore throats, probably because it has a mild blistering effect.

Lasiosiphon Kraussii, Meisn.—This is a small compact bush with many green stems which grow fresh each year from a rootstock. The stems are usually about 12 to 18 inches high. The leaves are more or less oval, sometimes densely hairy and

up to 1½ inches long and ½ inch wide. The flower heads are dense, many flowered, often hairy; flowers pale yellow, (Fig. 3.)

Although this plant has been proved to be poisonous to stock in South Africa, no evidence has been found in this country that it is ever eaten by stock. It appears on burnt ground before the rains and before there is much new growth of grass. These are the conditions which are usually unfavourable as far as stock-poisoning is concerned, as the cattle are anxious to get green feed wherever available. It is usual, however, for the stock in any country to become acquainted with the vegetation of their district and disagreeable or poisonous plants are not usually eaten unless they are browsed accidentally with other attractive food. This plant is widely spread through the eastern half of Africa from north to south and is found in the dry soils, never in vleis. Wherever the vleis have been burnt during the dry season there is usually green grass present and native cattle normally graze in the vleis and not on the dry ground at that time of the year. Losses of stock from this plant are only likely to occur in cattle recently introduced from places where the plant is not known.

Gnidia chrysantha, Gilg.—This is one of the brightest flowers which is to be found in our vleis during the months of October to December each year. It never grows in compact bushes like its relative *Lasiosiphon Kraussii*, which is common on burnt ground before the rains begin, and its leaves are very narrow and scattered up the stems. Usually four or five stems arise from the same base and the flower heads are pale yellow or orange or deep red. The darker variety was at one time separated as a distinct species and named *Gnidia ignea*, Gilg., but it is nothing more than a variety, and heads of different colours can be found on the same plant (fig. 4).

This plant has not been proved to be poisonous to stock, but it probably contains an irritant similar to that found in the other members of the Genus. It is apparently not eaten by stock because it does not put on new growth until the ground is wet, when there is abundance of green grass available for the cattle.

The Treatment of Irritant Plant Poisons.—The majority of plant poisons act as severe irritants and are generally associated with colic or severe stomach pains and usually with obstinate diarrhoea. These are best treated in the following manner, which is based on the results of Dr. D. G. Steyn's work at Onderstepoort.

1. Keep the animals quiet and in the shade. On no account should they be driven.

2. Do not allow animals which show signs of plant poisoning to drink water until the symptoms abate, as this will facilitate the rapid spread of the poisonous substances through the body.

3. For grown cattle give at four hourly intervals a bottle of raw linseed oil and lime water, half and half, to which 4 grams of tannic acid has been added. This mixture should be kept on all farms and ranches where suspected deaths from plant poisoning occur. In case carron oil, *i.e.*, a mixture of equal parts of raw linseed oil and lime water is not available, the oil may be given alone. Linseed gruel or the whites of six to ten eggs beaten up in milk will also help to relieve the irritation.

4. From 4 to 8 ozs. of glucose in a bottle of water or milk should be given every few hours in cases of plant poisoning, as the liver cannot function in getting rid of the poison without sufficient carbohydrate.

5. As soon as the animal shows signs of recovering keep it supplied with fresh green feed and plenty of clean water.

Thunbergia lancifolia, T. Anders. (*Acanthaceae*).—A compact green herb-like bush usually 15 to 20 inches high with numerous stems, narrow glossy green leaves in opposite pairs and deep purple or purplish blue flowers with a deep orange throat. It is one of the first plants to flower on burnt ground before the rains, and continues flowering on land which has not been burnt over until Christmas or well into January (fig. 5). The flower is remarkable in some respects. The

stamens, four in number, are in two twin pairs; the anthers (pollen sacs) have pointed spurs above and beards below, and the stigma is funnel-shaped, triangular above with incurved margins. Widespread and common; flowering October to January.

Two Plants of the Borage Family (*Boraginaceae*).

Trichodesma physaloides, A.D.C. (fig. 6).—This is another of our commonest wild plants which flowers just before the rains on burnt ground or up to December on land which has not been burnt over. It grows new shoots from a thick rootstock each year and usually forms a compact bush about 18 inches high. The leaves are pointed, usually about 2 inches long and ¾ inch wide in the middle, rough, with white tubercles on both sides. When the leaves dry they turn dark brown, conspicuously dotted with white. The flowers hang down and are more or less bell-shaped. They are about 1 inch to 1½ inches in diameter and vary a great deal in colour from pure white to blue or blue with yellow spots. The flowers bruise very easily and turn brown or black after even careful handling. When the flowers are over the green calyx becomes enlarged and looks something like the husk of a Cape gooseberry. The scientific name of the flower (physaloides) is derived from this character as Physalis is the generic name of the Cape gooseberry.

Trichodesma zeylanicum, R.Br.—This is an annual weed of cultivated lands particularly common on red soils. It is easily recognised by its hairy leaves and pale blue flowers with a white centre. The flowers are smaller than in *physaloides*, being only about half an inch in diameter. It is common throughout East Africa and also in India and Australia.

Two Bauhinias, both scrambling shrubs (*Leguminosae*).—The Bauhinias are easily recognised by their deeply two-lobed leaves, the two halves folding together like butterfly-wings. Mopane has a similar habit, but more pronounced. Many Bauhinias are trees, but the two illustrated here are scramblers which come into flower about the time of the first rains.

Bauhinia punctata, Bolle.—This is the well known perennial shrub which is wild in all parts of Southern Rho-

Fig 5 — *Thunbergia lancifolia*, Common flowering in November

Fig 6 —*Trichodesma physaloides*, Salisbury Flowering in November.

Fig 7 *Bauhinia punctata* (Galpinii) Office garden Salisbury November 11th, 1938

Fig 8 *Bauhinia tassoglensis*, Klotsch Salisbury street sides Flowering October November

desia which lie at about 3,500 feet altitude or lower. It is common around Umtali, Shamva, etc., and is at once recognised by its masses of bright pale brick-red flowers. It has long straggling branches which may droop to the ground as in fig. 7 or it may climb to the tops of other trees twenty feet or more from the ground. The flowers have only three or four perfect stems out of ten, the others have no pollen sacs (anthers). It was known for many years as *Bauhinia Galpinii*, so named after Dr. Galpin, the South African botanist. It was later discovered, however, that it had been described and named many years before, and the first name given has to be adopted. It is often planted in gardens where it does remarkably well, even at higher altitudes. It is common in Salisbury gardens.

Bauhinia fassoglensis, Klotsch (fig. 8).—This bright creeper is common, particularly on red soils, flowering in October to December. Its branches remain green and grow afresh each season from a very thick underground stem. The young stem and main veins of the leaves are usually covered with a dark brown pubescence of short hairs. The leaves are large, and are dark green or green with chocolate-coloured edges and blotches. The flowers are in clusters, bright canary yellow in colour with only two perfect stamens. The branches are often from 6 to 10 feet long and are usually flat on the ground, but, having tendrils may climb over any available bush. The pod is flat, very wide, usually with 2 or 3 seeds. Common and widespread on red soils where the rainfall is 25 inches or more.

Soil and Water Conservation.

By D. Aylen, for the Irrigation Division.

INTRODUCTION.

Position in Southern Rhodesia.—In Rhodesia we have problems similar to those in many other parts of the world, and among the most serious of these is erosion, as yet not so far advanced as elsewhere, but probably more rapid in its progress, consequently it is to-day receiving most serious consideration.

Desiccation and erosion have begun, and many parts of Matabeleland which were well grassed and watered by permanent streams forty years ago, are to-day denuded of cover with the result that the river-beds are now filled with sand and during the dry season have little or no flow of water. In Mashonaland the areas of rich virgin soil which had been opened up during the days of the early settlers have in most cases been exploited without any regard to the future, in other words "mined," and the soil impoverished by continuous cropping and erosion until many of those lands have been abandoned as useless. The best land is usually the worst sufferer, owing to the owner's blind faith in its supposedly inexhaustible fertility. Conversely the best farmers are often found among those who have had to struggle with poor shallow soil and have realised its limitations and the danger of erosion. In many cases farmers try to extract a living from an impoverished soil without any attempts either to improve it or control erosion. Owing to the decreasing yield, the acreages are extended in order to obtain larger crops, and this process continues whether prices are high or low. When prices are low every effort is made to increase the volume of production in order to meet working costs, and when prices are high the farmer is still anxious to take advantage of the apparent opportunity for a bigger return.

ALTERNATIVE METHODS OF FARMING

EXPLOITATION

Hollows ploughed across. Note the gulley and sheet erosion. (Light patches indicate extreme depletion.)

CONSERVATION

Pastures and belts of trees. Contour working of the land. Green-manuring

In the earlier settled districts this policy of exploitation has almost ceased, as the majority of this type of farmer has been forced to farm better or give up.

The policy of exploitation is a short-lived one, and can have only one end—abandonment of the land. Good land is not plentiful, and every acre sacrificed to a temporary cash return means a loss of capital, which neither the individual nor the country can afford. Exploitation is the more expensive process in the long run, and must be replaced by conservation.

Soil conservation is a wide term, and is not confined to "contour ridging," but includes any and all measures aimed at both protecting and conserving the soil, and it is imperative that the wise use of land and good farming practice should follow the first step—protective works.

Upsetting the Balance of Nature.—Under its natural covering of vegetation the earth's surface maintains a balance. Rainfall is checked when it reaches the earth, and a maximum amount is absorbed and made available for plant growth and the replenishment of the underground reservoirs, which in turn feed the springs and maintain stream flow. If the vegetative cover is removed by any agency the amount of rainfall lost by direct run-off and evaporation is increased at the expense of absorption and a process of accelerated erosion begins at once. The exposed surface of the earth is torn away by the rush of water and before long unproductive sub-soil is exposed; floods increase in violence, rivers are swollen beyond their bounds and in many cases cause extensive damage; the clear waters of the rivers are turned into torrents of liquid mud, and dams and weirs are silted up at a disastrous rate.

The reduction of the amount of water absorbed leads to a falling-off of the flow of springs and streams and to the disappearance of wet vleis. Further underground supplies to wells and boreholes are diminished, and the "water-table" falls steadily. It is well known that many of our rivers and streams are yearly decreasing in dry season flow, and only a very few minor streams have their sources adequately protected from erosion, fire and over-stocking. To this extent there is foundation for the oft-heard statement that "the

country is drying up." It is not that the climate is changing, but that the rainfall is becoming progressively less effective, mainly as a result of increased evaporation.

Evaporation.—The losses of water through run-off, particularly flood run-off, are so strikingly obvious that it comes as a surprise to most people to learn that evaporation losses are actually very much greater, although invisible and difficult to measure.

The quantity of water completely lost by evaporation and removed by the wind is considerable. The actual amount amount removed has not yet been determined for the Colony. We do know, however, that the evaporation from open water is six to nine feet per annum, that water can be evaporated more rapidly from damp exposed soil than a free surface of water, and that temperature extremes and wind velocities are greater in bare areas than in forests.

In Matabeleland during a normal wet season sixteen-day droughts occur on an average about once a month. It has been calculated from measurements that the rainfall which it is possible to lose by evaporation from a bare exposed soil during these periods is just over $10\frac{1}{2}$ inches per annum. The loss by evaporation from a bare soil in Mashonaland is between 6 inches and 8 inches per wet season.

The usually accepted cycle "of a warm wind picking up water when passing over the sea and later dropping rain on the land" can work just as efficiently in the other direction, very often more so, as frequently air temperatures over land are higher than over sea.

With these explanations there is no doubt that the drying up of the country is to a very great extent due to the fact that removal of vegetation permits, through exposure of the soil and increased wind velocities, an increased evaporation, and whilst with favourable conditions this water will condense and fall as rain again, with unfavourable winds it is taken away.

Without this explanation it would seem that if run-off from an occupied area could be brought back by suitable methods of control to what it was in its primitive state the

underground water supply would remain unchanged. This happy position is unfortunately not correct. The effect of the removal of or thinning of herbage, trees and surface litter must be offset by causing more water than before to penetrate if "permanent" water is not to dwindle.

The position in Rhodesia is reaching serious and unmistakable proportions. As it is the most important of our present problems and hitherto has received little beyond the barest considerations, water conservation is dealt with first and receives greater prominence than the other conservation subjects in this bulletin.

PART 1.—WATER CONSERVATION.

CHAPTER I. IMPORTANCE OF THE PROBLEM.

The Results of Development.—It is necessary for the occupation and development of a country that much of the natural vegetation be removed. The upsetting of the balance of nature to some extent cannot therefore be avoided, but a great amount of avoidable damage is done by other means than the necessary and legitimate removal of natural vegetation for the purpose of cultivation.

Even with the most careful methods of development some effort must be made to restore the balance. Unfortunately in Rhodesia as in every other country development has led to much destruction through carelessness, lack of knowledge and forethought, and even cold blooded exploitation.

Factors which have influenced the rapidity of the problem.—Erosion and drying up are most rapid in Southern Rhodesia, perhaps because soil, climatic and other conditions are highly conducive to the formation of unfavourable soil conditions for absorbtion of rain and resistance to erosion, which results in the reduction in the underground water supply.

The removal of natural vegetation and subsequent erosion in arable lands certainly adversly affects the water table, but to a very small degree, compared to the maltreatment of the veld and grazing by overstocking and burning which have led to the formation of a hard impervious surface cut up by gullies over larger areas.

Burning and overstocking remove all protection from the soil, as the overstocking reduces the shade and fire destroys the half-rotted grass. The bare soil now exposed to the sun, wind and rain dries out and may crack. The rain-drops beat the surface hard and the turbid water which is formed closes the pores and fills the cracks with silt. Owing to the removal of the source of supply of humus and the action of sun and rain the surface eventually becomes almost impervious. The relatively large sized rain-drops and high intensities, the hot dry periods between storms and the long dry season are all favourable to the formation of an impervious surface on burnt or over-grazed veld. The remaining grass gets less and less water, and naturally becomes poorer and poorer, in quality and quantity. A vicious circle, less grass, less water; less water, less grass.

The increased run-off causes gullies in the now poorly protected valleys which further speed up the removal of surface water and drain away or expose water immediately below the surface.

If top-soil is removed by sheet erosion, run-off is further accelerated.

The inevitable lessened water supply and reduction in number of watering places mean that cattle have to be moved greater distances to water or concentrate at places where water is available, involving intensified tramping and numerous cattle paths, each a potential gully, all of which jeopardise for the future the remaining supplies. Serious overstocking on its own (mainly due to the trampling of the animals' feet) can on certain soil types bring about the formation of a hard impervious surface, especially where animals are herded. On such a soil, whether caused by fire or trampling, a hard, bare, and impervious surface recovers most slowly, even when completely rested.

Once the balance has been upset the process continues with increasing momentum without further assistance. Efforts are now being made to arrest the progress of the complex problem of soil and water wastage, but not enough to counteract the past and present damage. To ensure for the future it is necessary that the best methods of agriculture and veld

2. Slow recovery of badly trampled grazing.

3. Severe injury to trees and grass. Regular fires have made the soil impervious.

4. Arizona range ruined by maltreatment.

management be employed and sufficient soil and water conservation work be done to counteract the effect of legitimate and careful land use as well as to repair the damage caused, and still being caused, by misuse and destruction.

Isolated small areas of intensive work will cause some increase in the underground water level within the area, but in many cases much of the water will be drained away into the neighbouring areas. In certain cases, as for example, above a previously wet, but now dry vlei, localised work above will be completely adequate, but for any very marked general improvement universal co-operation is essential.

CHAPTER II. SOIL AND WATER CONSERVATION ARE INSEPARABLE.

Pertinent Facts.—Erosion on a sheet eroded surface is one-third greater than from a non-eroded surface, other conditions being equal.

The run-off from a soil deficient in humus is from one quarter to one half greater than for a soil well supplied with humus, and the erosion is about double.

The moisture that a soil can retain varies according to the amount of humus in it.

A really good pasture cover looses only half as much rain-water by run-off and a minute fraction of the soil compared to a ploughed land. Poor veld, however, looses more water than well worked land.

Soil "porosity," *i.e.*, a soil structure that is granulated or loose and full of spaces, is the most important factor controlling the absorption of water.

The main factors effecting water supplies is, therefore, veld conservation. When veld has been severely damaged, rest alone will not suffice to effect recovery, mechanical means such as spreaders, furrows and breaking of the crust must be used. Details of these will be given later. Prevention is the best and cheapest.

As regards crop production, the all-important factor in a climate such as ours is the quantity of rain water which is

absorbed in the soil and held available. It is not generally known that crops suck up and transpire huge quantities of water; in the case of maize, for example, it takes between 25 and 35 tons of water to produce 100 lbs. of grain, and this gives us a figure of 18 inches of rainfall for the total loss by evaporation and transpiration per season, also during heavy rains several inches will be lost as run-off and penetration to depth. It is thus clear that without adequate control designed to conserve the rain water heavy crops cannot be grown.

Reasons for Condemning Veld Fires.—Veld fires are the biggest cause of increased run-off and evaporation and the biggest single factor which is responsible for the reduction of underground water supplies, let alone the destruction that follows in their wake mainly of a secondary nature in deterioration of herbage and soil structure and erosion. The direct and immediate damage caused by fires is quite apparent, but is only a fraction of the indirect damage which fires "permit" to come about, chiefly a most undesirable change in surface soil structure, from the point of view both of infiltration of water and growth of herbage. The change in surface soil structure is slow but certain and does not cease immediately fires are stopped, but continues until good cover has been restored, and improvement does not commence until a mulch of decayed material has been formed on the surface. The extent and rapidity of the process of deterioration and restoration also both depend on the soil type, type of herbage, rainfall, slope and, most important, the extent to which the area is grazed.

Fireguards.—It comes as a surprise to find that so few farmers and ranchers make fireguards and that the majority of those made are not sufficient to relieve anxiety when a fire is sweeping down on the property. Many fireguards as made at present are a fruitful source of gullies. The usual practice, that is to burn a narrow strip of grass about five yards wide between a few plough furrows, is not satisfactory, as it causes erosion and is not safe. *The actual burning of this type of fireguard often causes a veld fire!*

The safest method of making a fireguard, and one least likely to cause erosion, is to mow towards the end of the

growing season strips about five yards wide either side of a strip about 25 yards wide. Burn or rake up the grass on the side strips immediately and later burn the centre strip as soon as it is dry enough; do not wait till August or later, when everything is tinder dry.

Roads can be utilised to help reduce the cost in some cases.

It will be argued that this method is costly to commence in treed areas as it means stumping, but it is only a fraction of the cost of fencing, and once done the yearly cost is less than any other method. The danger of the fireguard getting away is negligible. A further advantage is that there is a lane along which one can get with a truck and fire-fighters in the case of emergency.

Veld Management.—With the intention of taming the veld, areas are often deliberately burnt and overstocked. Regular burning and overstocking can do incredible damage to the soil, water supplies and the grass.

In order to remove indigestable grass it may be necessary to burn. From an erosion point of view the controlled burning over quite a long period of years of a close stand of grass does little harm, but the damage which is done to the underground water, though considerable, is not immediately apparent.

There is no room for doubt, however, that the burning or overstocking of areas of scattered natural timber (bush veld) very soon leads to the formation of an impervious surface on many soil types, and even on gentle slopes, serious sheet erosion, and, of course, great deterioration in the grass.

Judicious felling of trees on hillsides is often found to improve the grazing and provide a better cover of grass, provided that over-grazing and repeated burning are avoided. It should be made a rule to prevent grazing on recently felled land until the grass has become well established.

In open country regular annual burning, or even mowing, especially when combined withoverstocking, eventually leads to trouble. As a rule water supplies suffer first, soon to be

followed by sheet erosion and lastly deterioration of the grass owing to failure of the best types to re-seed.

Many ranches are forced to burn the veld every year owing to the presence of a heavy uneatable cover. As a result a palatable grass appears for a short time after burning, but this practice eventually leads to conditions even worse than formerly existed. After fires only the stronger and least valuable grasses survive. The plants and seeds of the better grasses are destroyed and in a few years the grazing can completely change its type. When this stage has been reached, if the animals are not to die in September-November, the rancher *must* then burn the grass, as there is nothing to eat. The grasses get scantier and worse each year.

A complete rest at intervals appears to be the solution, combined with reduction in the number of stock below carrying capacity for some time afterwards, controlled grazing by fencing, future limitation of numbers of stock to carrying capacity and, if possible, provision of hay and other winter feeds.

It appears at present to be an economic impossibility to manage veld grazing as one would like, that is, the provision of adequate fencing so that rotation of very short periods of intensive grazing may be practised, the removal of surplus grass by mowing, the making of adequate supplies of hay from young grass, the provision of more drinking places, the necessary soil and water conservation works, and many others. However, those are the ideals at which to aim. Each farmer and rancher must decide for himself how much of the programme is economically feasible and do it. Any part of the programme will effect some improvement.

It cannot be too strongly emphasised that unless checked, the drying up of water supplies and deterioration of grazing will sooner or later bring disaster to many areas.

When putting up fences much may be done to prevent erosion by planning the paddocks and gates so that the animals have as little walking as possible to water, work, milking shed, dip tank, etc., and that if possible, on the contour. Gates, water, salt licks, shelter and supplementary feeding places should be well scattered over a paddock otherwise the

animals, especially if previously herded, will congregate in a bunch causing danger spots for erosion. Animals which have been bunched will soon spread if this system is adopted, greatly to their benefit.

Each paddock should have water in it. A well or borehole or a piped supply from a small dam can be made to serve four paddocks if the fence lines cross at that point.

Boreholes are often the only means of providing water, but they tend to decrease the underground supply, and for that reason are not to be compared with systems of small dams with soil-and-water conservation works above them, which improve the underground supplies, the grazing and the flow in streams.

Very often the run-off from a bare surface such as a road may be utilised to provide drinking places with the first storms before the set rains. They may be constructed by sloping off old gravel pits or making shallow sumps or small dams, and leading the storm water by drains into them.

To sum up, make the water penetrate where it falls if possible, store as much of the surplus as is practical in dams. Do not drain vleis, or dig out springs. If bogs are a danger to cattle, fence them off. Stop erosion in gullies, and if draining sub-surface water, block them. Catch the potential gullies at once. When feasible, spread flood water over pastures. Re-align old eroding drains and also roads if possible, and construct all new drains on easy gradients, taking the water, if possible, back to the bottom of the natural valley.

CHAPTER III. METHODS OF CONSERVING WATER.

In order to attain the best results for the least expenditure as much rain water as possible should be held when it falls.

Surface Treatment.—Where trees are few and the land is not excessively steep much may be done to improve the penetration of the rain water by using a spike roller or cut-away disc harrow; the latter being the better implement. Even a heavy Scotch harrow would do something to break the crust.

Conservation Devices for Natural Pastures and Veld.

Pasture Furrows.—The usual practice on gentle sloping grazing in America, and one which has brought about great improvement in the grass by conserving moisture and controlling erosion, is to make small furrows exactly on the contour at close intervals. These furrows not only hold up water and provide an entrance into the soil, but the movement of the water down the slopes is considerably slowed up, and the water is also prevented from concentrating in the hollows, being spread evenly over the whole surface. Thick grass soon grows adjacent to the furrow, and acts as a filter removing the mud in the water, which would otherwise seal up the pores of the soil. Even if the furrow becomes almost obliterated a miniature terrace is formed.

The actual construction of the furrows is most simple and cheap; many of the implements which every farmer has can be used to do the job. Any make or kind of disc plough with all but the back disc removed is perhaps the most suitable and convenient in this country. A single furrow plough with an extension on the mouldboard will do just as well, except when the soil is stoney or full of tree roots. On soft soils when wet one duckfoot tyne on a strong single row cultivator, or a ridging or potato plough, could be made to serve the purpose.

A furrow about 6 to 8 inches wide and 4 to 6 inches deep is all that is required. For best results the soil should be thrown *upwards*, and clear of the furrow, and left in an even unbroken row. This is not difficult with a plough if the soil is damp. If done in the dry a light roller will smash and smooth out the clods and spread out the soil in a thin layer through which the grass underneath will have no difficulty in penetrating, and therefore only about 1-20th of the original cover is destroyed. Small gaps in the banks can be rapidly filled by hoes. However, any sort of furrow has brought some good results in America.

If a big plough is used half a span or less will easily pull it. Other than supervision and pegging, costs will vary from 3d. to 1s. per acre.

The work can be done in thinly treed areas, as on meeting obstruction such as trees, the furrow is taken close above them or a short length is left.

When it is desired to make these pasture contour furrows level lines are pegged with a distance between pegs of about 25 feet, and the lines about 50 feet apart. On crossing shallow depressions, waterways, or footpaths, the line is bent up slightly above the true line of levels; on meeting deeper waterways or gullies, the furrow is bent up as before but not continued across the bottom, a gap being left.

The spaces between the furrows are then accurately sub-divided and other furrows put in, after which they are again sub-divided, so that eventually the furrows are about 12 feet apart.

The original spacing depends upon the type of soil and cover and the slope, and how much of the pasture can afford to be temporarily destroyed. In certain cases it would be advantageous to again sub-divide the following year. If this were done correctly it would be possible to prevent all run-off from veld so treated.

As the furrows become partially filled and smoothed out during the first wet season, they offer no serious obstacle to hay mowers.

On mal-treated veld water penetrates very slowly so that where possible this system possesses several advantages over the usual type of contour ridges as used on arable land, which are designed primarily to stop erosion, and cause increased absorption of rains in the land between them only because all field work is done on the contour.

Storm Water Irrigation.—Storm water may be taken out of gullies and spread over a contour-furrowed pasture when the slope is less than 1 in 40 as soon as the grass has commenced to grow on the furrows. It is possible, therefore, to use flood water to "irrigate" the pasture and so supplement the rain for a short period after each storm, thus securing deep penetration.

The conversion of a sharp storm with a quick run-off into a long soaking supplemented by additional water applied

towards the end and shortly after the rain, must do immense good. Light showers and sharp storms of short duration, which would otherwise do little or no good, are now more beneficial, as owing to the length of time the water is in contact with the soil the absorbtion is greatly increased.

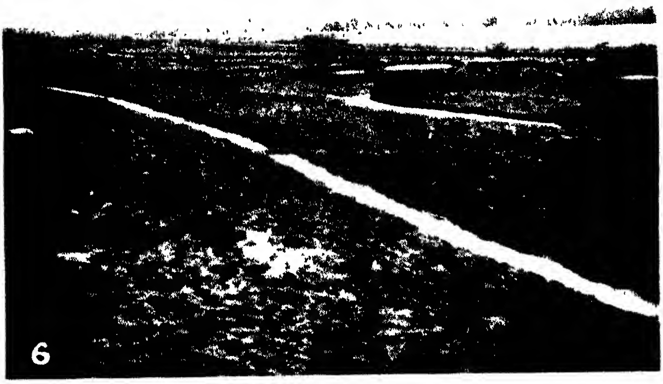
Water with a high content of very fine silt should not be spread over pastures, as the clay deposited forms an impervious seal.

In order to extract flood water for this type of "irrigation," either a weir or dam with an unusually wide spillway is put across a gully at a convenient point and water is led out by a suitably placed and controlled sluice a little below the level of the spillway. Advice should be sought so that the outlet will not be a danger to the dam in high floods.

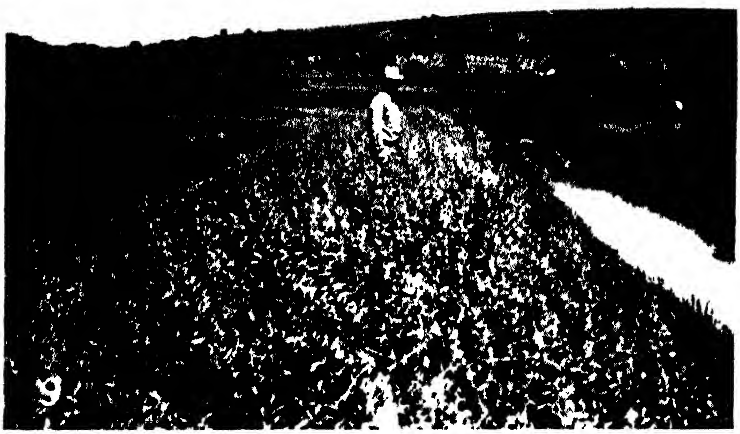
The water is then taken in a ditch to above the furrowed area, where at regular intervals small amounts are allowed to escape through pipes or weep-holes in the bank. Three or four inch galvanised iron down-piping would do provided the ends are protected from being trodden on by cattle. Dry stone "weeps" and also narrow spillways can be used in other cases.

If grass cover is very poor below the outlets, the water should be spread by "wide arrow" shaped strips of thick couch grass, or a very low fence of tresh, or fine wire mesh 6 inches high. The point of the arrow should be close to the outlet.

Flooded Contour Ridges.—On almost flat arable or pasture land flood water may be taken in a similar manner and spread by a system of level close-spaced contour ridges. There are several methods. In one the water can be taken in a ditch down one side of the field and a portion abstracted at each ridge, eventually soaking in or escaping at the far end. In cases where the land is porous and not liable to water logging, the water soaking in quickly, the flood water can be diverted into level terraces from a drain by low bolsters in the ditch which allow the ridges to drain back into it during heavy rain. That is, if run-off occurs from the area above it is utilised to irrigate the land below, whilst during heavy rain there is no danger of the ridges breaking.



5. Rhodesian pasture furrows as described in the text
6. Pasture furrows after rain
7. Rapid improvement in grass growth along the furrows
(Figs. 6 and 7. courtesy of U.S.A. Soil Conservation Service.)



8 Diversion bank with weep holes. A device to spread water over a pasture.

9. Broad level contour ridge Closed spaced on a gentle slope for water conservation.

Where the land is inclined to water-log owing to an impervious strata a very few feet below the surface, prolonged soaking as would be caused by level ridges with ends closed to a height of six inches below the top of the ridge, would prove detrimental to crops.

Standing water in the lands can be overcome by making a ditch either side of the land and giving the ridges a very gentle fall in alternate direction. The water is zig-zagged backwards and forwards across the field. A portion of the flood water is led into each ridge, provided it is not full (during the flood period the main flow goes down the ditch) and eventually escapes at the far end into the ditch to pass into the next ridge or go on according to the height of water in the ridge.

In America, by these various means of utilising flood water for irrigation, fair crops and pastures are being grown in areas with as little as 7 inches of rain.

Contour Ridges and Furrows.—On other than gently sloping land it is doubtful if pasture contour furrowing would prove satisfactory by itself, except due to the extra penetration caused by disturbing the crust, as the furrows would be inclined to fill rapidly and could not be sufficiently accurately constructed to spread the water. The concentration which would take place would be liable to cause minor washes unless the volume of water was restricted.

Here the best known practices are to construct normal type contour ridges on a very easy grade and place a few plough furrows at intervals on the exact contour between the contour ridges, or small contour ridges at close intervals.

True "pasture contour ridges" are made fairly wide and about one foot high when first constructed. As is the case with contour ridges on lands the shape depends on the slope of the ground. Spacings are from one to two feet vertical interval or 75 to 30 feet horizontally according to the slope.

Very large contour ridges on the level with semi-closed ends have proved satisfactory on gentle slopes with porous soils. On less porous soils weep holes and spreaders might be included.

Contour Ponding.—Where it is desired to make flood waters penetrate above a vlei, for example, the water can be led to a large contour ridge or dyke some 3 feet in height which is on a very gentle gradient or even level with a semi-closed end, according to its length and the volume of the flow. If long and on a gradient small ribs can be run out at right angles to the "dyke" at intervals of 100 yards, the top of each rib being level and about six inches below the crest of the dyke. The greater part of the rib is made at the same time as the "dyke" but a small section of the main channel left open (*i.e.*, adjacent to the dyke). Couch grass is planted on the rib and as soon as it well covers the rib the opening can be closed, and the water allowed to pour over the grassed length. By this means a series of ponds are created. Such a scheme should be placed just outside the paddock fence or where cattle cannot walk over the banks in wet weather.

On the top of a flat domed hill a series of level contour ridges may be put round so as to encircle it, with spillways at intervals to avoid overtopping.

The last two more elaborate schemes are fully justified when it is desired to improve vleis, wells or boreholes, but they are not primarily designed to improve pasture in the immediate vicinity.

Either for flood control or for purposes as described above, on steep hillsides single-sided contour ridges with ribs about 25 feet apart can be designed to hold up all water, except during the most severe storms. In place of ribs lengths of pits may be constructed in the ridge channel; in cases where porous sub-soil conditions suit this method maximum absorbtion with minimum evaporation is attained. In practice a scheme probably would usually partake of both these methods.

Treatment of Vleis.—The quantity of moisture available for the grass is one of the main, if not the main, factor in obtaining good pastures. Water penetrates relatively slowly on most grazed areas; by lengthening the time during which water is moving over the surface much more may be made to penetrate, except in the case of almost flat vleis which become waterlogged during the wet season. Many of these vleis

become cracked and dry during the dry season. In this case much has been achieved by preventing surface water from above running into them during the rains and making it penetrate the land above so that it slowly percolates down to come out at the time when most needed. The vlei is thus improved in both summer and winter. Many of these vleis are drained by gullies which cut off and lead away the water. The gullies should be blocked.

Staggered Contour Ridges.—Another method of conserving or utilising storm water is contour ridges with staggered breaks. This method is primarily of use when it is desired to hold back for a time and check the rush of storm water which is to be used for storm water irrigation or to reduce the peak flow in a gully. It has the advantage as well that penetration is greatly increased on the treated areas.

Need for Careful Planning.—Before any of these schemes are adopted careful consideration must be given to the expenditure which is economically justified, the natural conformation of the land and the type of vegetation present, and the type of soil and sub-soil. The usual solution would be a combination best suited to the particular case. Most of the schemes require a technical knowledge greater than for plain contour ridging and greater care in construction, and advice should be sought before embarking on any scheme.

WATER CONSERVATION ON IMPROVED PASTURES.

Where a relatively high expenditure is justified as, for example, improved pastures such as Kikuyu, Rhodes grass, paspalum, common couch or forage crops of oats or lucerne, for breeding stock, fattening or dairying, there are other methods which in these cases amply repay their cost. They must all be constructed before planting the grass or forage.

The "Ridge-and-Furrow."—The first is the "ridge-and-furrow," which consists of forming the land by repeated ploughings into smooth undulations, anything from 15 to 30 feet wide and about six inches high. The length and height of these undulations is on a gentle gradient varying according to the proneness of the land to be too dry or too wet. Trials have shown this method possesses great possibilities in

Rhodesia, but most careful examination of the site is required before such a scheme can be recommended. Surplus storm water from another area above may be led into the system.

Bench Terraces.—Excellent pastures are being grown in Rhodesia on level or almost level "bench terraces." The minimum of rainfall is lost and the benches may be irrigated either normally or by flood water.

"Listing" or Contour Rows.—It has been generally advised that on all but flat land which is to be sown to grass contour ridges must be put in. Rain water could be held up on all the surface if, before planting the grass, or the previous green manure which is a most desirable practice, the land were ridged as for tobacco or potatoes, the ridges being subsequently slightly smoothed with a light harrow. The ideal implement would be a basin lister which makes shallow depressions about 18 inches wide in varying lengths from 5 to 15 feet. It would not be impossible to imitate the work of this implement with a shovel-or ridging-plough. The ends of the basins should be staggered and the length should be on the contour. In this type of work the rows or basins should be commenced just below and "parallel" to the upper contour ridge on each strip and each subsequent row below the last.

Nature's Part.

Assistance to Nature.—In any and every case, when it is desired to make more water penetrate every effort should be made to assist Nature. Encourage as thick a cover as possible, both of herbage and litter. The water will be slowed up, the surface prevented from becoming hard and the water will not be muddy to choke the pores of the soil, but clean and able to penetrate. There is a great difference between the rates of penetration of clean and turbid water. Evaporation will be reduced.

Rest the pastures and stop fires. Only when these do not achieve the desired result, or it is obvious that alone they cannot achieve it, or the pasture cannot be rested, should mechanical treatment be resorted to. Without some rest or reduction in stock, mechanical treatment brings slow benefits, but combined with a short rest remarkable results can be

12. Water storage. A farm dam.

13. Soil and water conservation. An earth check-dam to control erosion in a vlei.

14. Damage and loss of moisture. A cattle track in a pasture grows into a gully. Gullies drain off sub-soil moisture.

attained. By "mechanical treatment" is meant disc harrowing, contour furrowing, spreaders, and pasture ridges, etc.

It is recognised that in most cases it will be found next to impossible to sufficiently rest a pasture, therefore in the majority of cases recourse must be made to mechanical treatment to a greater extent than would otherwise be needed.

Dams.

Small Dams and Check Dams.—Under this heading may be included all kinds of small dams, check dams, bolster dams, and contour banks which are placed in vleis or valleys and designed to hold up a small volume of water for a period or slow up the rush. If a number of structures are placed at intervals in a valley permanent water may often be obtained in the lower ones even though none hold water more than a few feet deep, the seepage from the top one filling the lower ones many months after rains have ceased. Pastures have ben greatly improved by such schemes also.

In order to minimise the risk of cattle picking up internal parasites, such dams as have permanent shallow water in them should be fenced off. All dam walls should be fenced, in fact, to prevent damage being done by cattle.

Storage Dams and Soil Conservation.—In denuded and eroded areas, eventually all underground water supplies will be so seriously curtailed that in most cases the only method of obtaining water would be from storage dams. Under such circumstances, due to the violence of the flood water, the dams would have to be made larger and stronger and with unduly large spillways, and their lifetime would be very short owing to the heavy silt load in the flood water.

It is necessary, therefore, to control erosion in the catchment area above such works. It has been thought that soil and water conservation works above a dam would reduce the flow into it. Certainly the peak intensities of floods are reduced, but it is quite certain any soil and water conservation above will in the end benefit the supply to the dam, as the water held up will travel to it for a greater part of its journey underground, through the whole year, and safe from evapora-

tion. With a favourably situated dam water would still be running into it by underground channels late into the dry season.

WINDBREAKS.

A windbreak by reducing wind velocity will tend to decrease evaporation. The benefits which this brings about over the sheltered area greatly outweigh the local sapping effect of the roots.

By opening up the soil the tree roots in a forest or plantation permit a high rate of penetration of water. Thick forest litter forms an ideal mulch for prevention of evaporation and also retards the rate of flow of surface water and keeps the top soil in a porous condition. The shade protects the surface from the scorching heat of the sun. Rapid growing trees such as eucalypts, however, transpire huge quantities of water, and for this reason and also perhaps because of the deep opening action of the roots they often exert a local draining influence. For this reason gums should not be planted close to shallow wells and small dams.

A windbreak of willow, however, can reduce losses from a small dam fed by a permanent stream, as these trees transpire little moisture. They should *not* be planted on a dam wall.

When opening a new farm or new lands windbreaks of trees should be left. These barriers may be across exposed places and either at right angles to the direction from which comes the strongest wind or on the contour.

On a mountain slope the leaves of trees will cause the moisture of low clouds passing through the trees to condense; beyond this action there is no proof that trees bring rain. Afforestation of a bare area decreases erosion and run-off, and for that reason should occupy a prominent position in our conservation programme.

The "Gundry" Tobacco Furnace

By B. G. Gundry, A.I.Mech.E.

[Note.—*Owing to the large demand for this article it is now reprinted with additional notes to replace Bulletin* 996 *of August*, 1936.—*Ed.*]

Since particulars of this furnace were first published in 1934 it has been further tested at the Trelawney Tobacco Research Station, where it has given excellent results and attracted considerable attention. Very satisfactory results have also been reported by private growers who have tried it.

In order to overcome certain objections to the stoke hole being in the top of the furnace, as originally designed, an alternative design has been produced in which the stoke hole is situated in the front wall. As both designs have their respective advantages a drawing of each is reproduced herewith and for convenient reference these are designated as Types I. and II. The principle of their construction and working is, however, the same and there appears to be little, if any, difference in their general efficiency.

The important features of this furnace are its low fuel consumption, its cheap and easy construction and the ease with which the temperature can be controlled.

The Type I. furnaces installed at the Trelawney Station on 12 ft. x 12 ft. x 18 ft. barns fitted with 11 inch diameter circular flues, consumed on an average less than three-quarters of a cord* per curing over 14 curings. The consumption of a Type II. furnace installed on a standard 16 ft. x 16 ft. x 20 ft. barn also fitted with 11 inch diameter circular flues, averaged slightly over three-quarters of a cord in five curings. The highest consumption for either type of furnace reported by private growers was about 1¼ cords per curing.

*A cord of timber measures 8 ft. long x 4 ft. wide x 4 ft. high.

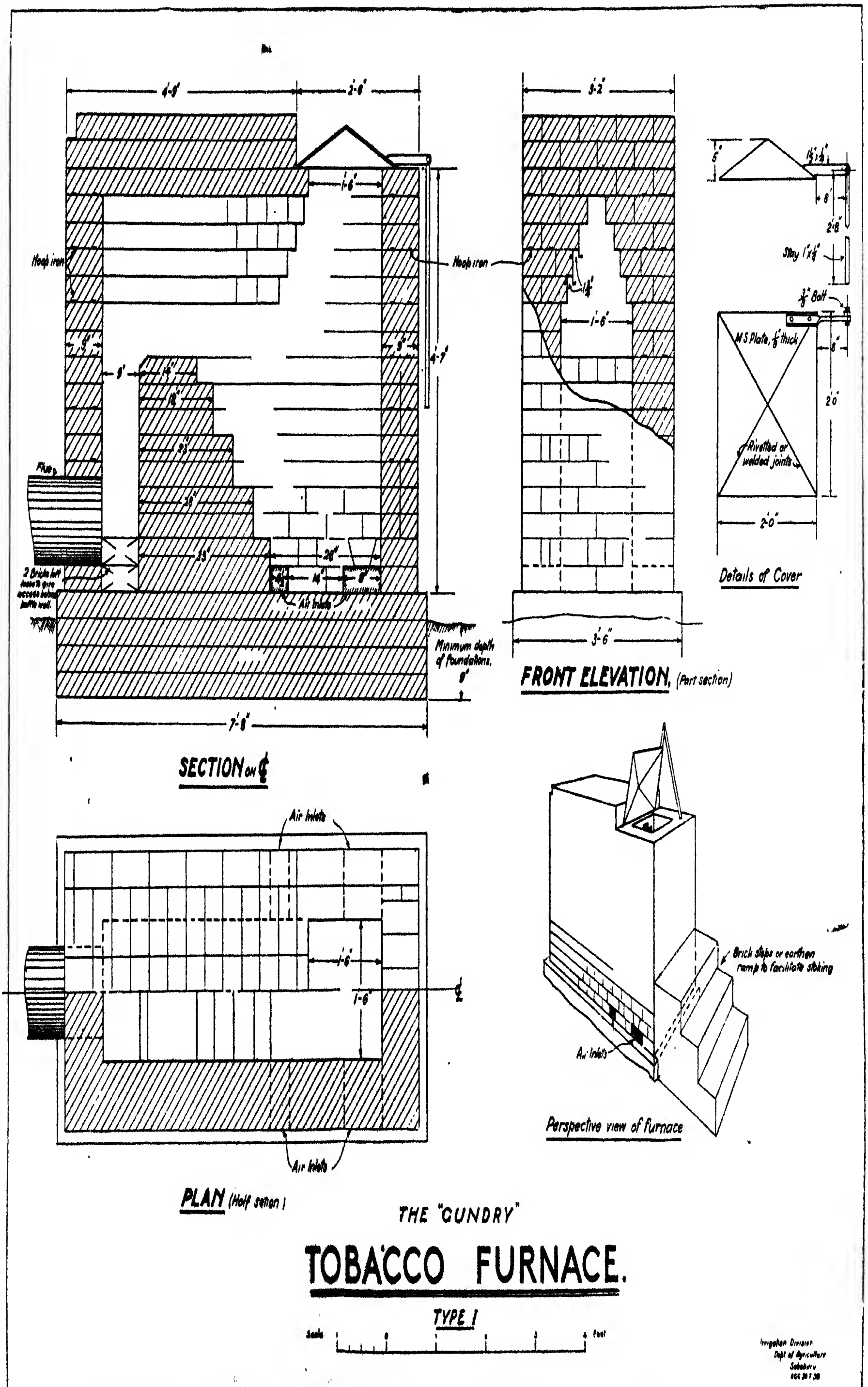
Reports also state that with this furnace the temperature can easily be maintained at a steady figure and can, if necessary, be raised very rapidly.

When used in conjunction with brick and iron flues it is unlikely that this furnace will give such good results as quoted above, as such flues are not so efficient as circular ones. It should, however, give a very considerably reduced consumption as compared with the ordinary open type of furnace.

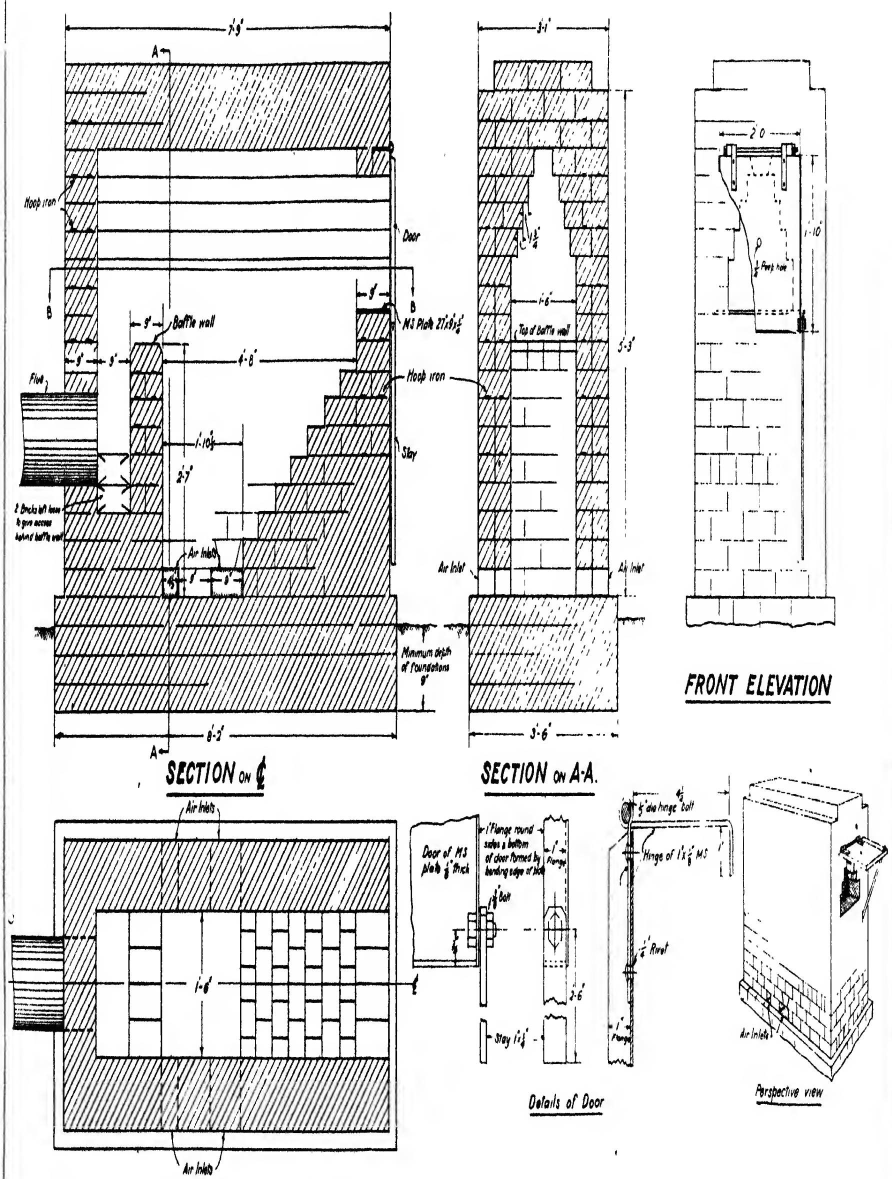
Construction.—The furnace may be built at any convenient distance from the barn, but it is not, as a rule, necessary or advisable for this distance to exceed 3 feet. Where a brick chimney is already in existence the furnace should be built fairly close to it and the flue taken through the base of the chimney. If more than a few inches of flue pipe is exposed between the barn and furnace it is advisable, in order to conserve the heat, to enclose it by building a low wall on either side of the pipe, an inch or so from it, and filling the space between with sand.

The excavation for the foundation should extend down to a firm compact formation and should not be less than 9 inches deep. The foundation should, for preference, be laid in lime or cement mortar, as these are far more permanent than "dagga." The top of the foundation should be not less than 3 inches above the ground level, but the height may be increased if necessary to suit existing conditions, such as the height of the barn floor or existing flues. In the drawing of the Type I. furnace it is assumed that the barn floor is only slightly above ground level and the flue is to be set about 7 inches above it. The Type II. furnace is drawn to suit conditions where the barn floor is about 9 inches above ground level and the flue is to be again 7 inches above it. It should be understood that the flue can be set at any convenient height in the back wall of the furnace which best suits the barn, but it is advisable to keep it below the top of the baffle wall.

When completed, the foundation will present a level platform of brickwork on which the walls are built. These should be built in "dagga" containing only sufficient clay to make it bind. If the "dagga" is naturally very rich it should



Hoop iron
Flue
2 Bricks left loose to give access behind baffle wall.
Air Inlets
Minimum depth of foundations, 9"
SECTION on ℄
FRONT ELEVATION, (Part section)
Stay 1" x 1/4"
Bolt
M S Plate, 1/8" thick
Rivetted or welded joints
Details of Cover
Air Inlets
PLAN (Half section)
Brick steps or earthen ramp to facilitate stoking
Air Inlets
Perspective view of furnace
THE "GUNDRY"
TOBACCO FURNACE.
TYPE I
Scale
Feet
Irrigation Division
Dept of Agriculture
Salisbury



THE "GUNDRY"

TOBACCO FURNACE

TYPE II

Scale — feet

Irrigation Division
Dept of Agriculture
Salisbury

have a certain amount of sand added to it to reduce the shrinkage. Care should be taken when laying the first course of bricks in the walls that the openings forming the air inlets are left in their proper places.

An opening, one or two bricks deep, should be left on one side opposite the space behind the baffle wall so that any ash which may collect there can be removed from time to time. This opening must, of course, be kept closed when the furnace is in operation by inserting loose bricks which should be plastered over with "dagga" to prevent the leakage of cold air into the flues.

It should be noted here that the dimensions given on the drawing correspond to standard brick sizes, and if the bricks used are approximately of standard size there should be no need to cut them, except to make the usual "closers" to obtain a proper bond. It will be found, for instance, that the outer courses of the Type I. furnace will be 4 bricks wide by 9½ bricks long, which will correspond very closely to the dimensions given, a difference of an inch or so will be of no importance.

When laying the second course of bricks the 9 inch air inlets should be covered by bricks cut to a "V" shape as shown in the drawing, and as a further safeguard against them collapsing pieces of thin sheet iron or a few lengths of hoop iron may be built in over these openings.

The inclined hearth and baffle wall should be built up with the side walls and should be bonded to them whenever convenient. The flue pipe is placed in position and built into the back wall at the required height. The walls, which are 9 inches thick, should be built in "Colonial Bond," *i.e.*, three courses of "stretchers" and one course of "headers" alternately. When the fifth course has been laid two strands of barbed wire or strips of hoop iron should be laid in each second course of brickwork as indicated in the drawing. These will check the cracks which subsequently develop in the walls and prevent them becoming serious as well as strengthening the furnace generally.

It is advisable to carry similar wires or strips of hoop iron through each course of the baffle wall in the Type II. furnace in order to strengthen it.

When the walls reach the proper height the side walls are corbelled or stepped out towards the centre of the furnace to form the roof. It will be noted that in the first, second and fourth course or corbelling, courses of "headers" have to be cut to the necessary length to give the required overhang of 1¾ inches. This overhang should not be appreciably increased otherwise the bricks will sag down when being laid and the ends may break off when the furnace is in operation. If any difficulty is experienced in laying these overhanging courses a straight piece of timber can be set up at the proper height to act as a support and guide for the bricks while they are being laid and afterwards removed when the "dagga" is sufficiently set. When placing the two top courses on the roof care should be taken that each brick covers the joints below it.

It is very advisable to protect these furnaces from the destructive effects of rain either by a permanent corrugated iron roof supported on four poles or a loose cover which can be placed over them in wet weather.

Metal Work, Doors, Etc.—In order to obtain the maximum efficiency from either type of this furnace it is essential that the stoke hole be kept closed with a cover or door when it is not actually being stoked.

For the Type I. furnace a proper cast iron furnace door would be the most satisfactory, but as these are expensive something cheaper is usually adopted. A flat piece of iron plate ⅛ inch thick has proved fairly satisfactory, but such a cover warps and buckles after a time and admits too much air. A square, prism shaped cover as shown in the drawing has been tried at the Trelawney Station and appears to be more satisfactory than the flat plate, but it has not yet been thoroughly tested and readers are advised to try out one or two themselves before purchasing or making a large number of them. Some growers have found old plough discs quite satisfactory, if however these are used the size of the stoke hole will have to be reduced to about 14 inches square, by

corbelling out the two top courses of brickwork. A strong wire loop is attached to the disc so that it can be lifted on and off with a stick or iron bar. The Type II. furnace requires a door hinged either at the top as shown in the drawing or, if preferred, one hinged at the side. It is probable that a door hinged at the top and having to be propped open is more likely to be kept closed when the fire is not being stoked.

Here again a cast iron door would be the most satisfactory, but in this type the door is not subjected to such intense heat as in the Type I. furnace, and at the Trelawney Station a door of $\frac{1}{8}$ inch plate has served its purpose quite well.

The only other metal work required is an iron sill placed on the bottom of the stoke hole opening. This is necessary to protect the brickwork from being broken away by the logs as they are pushed into the furnace. Two strips of old tyre iron would be quite suitable for the purpose.

Operating.—When the furnace has been built it should be left to dry out for a few days. It should then be given a trial to see that it works satisfactorily. A small fire should be lighted and the air inlets left open until the fire is burning freely and the chimney is "drawing." The air inlets may then be almost entirely closed with loose bricks so that the fire burns steadily. It is advisable to keep only a small fire going for several hours to dry out the furnace.

The fire can then be increased and the temperature gradually raised to the maximum required. It may be necessary to open the air inlets slightly, but it is rather amazing to find what a very small amount of air has to be admitted to maintain a large fire.

The size of the fire required to maintain any given temperature will depend on the prevailing atmospheric conditions and the efficiency of the flues and chimney. At the Trelawney Station, where the barns are fitted with circular iron flues and chimneys, it is seldom necessary to have the furnaces more than half full of fuel to obtain the maximum temperature. If any difficulty is experienced in getting the barns hot a careful examination of the flues and chimney should

be made to make sure that there are no obstructions in the system or that the flues are not thickly coated with soot or tar. It sometimes happens that in the angles or tee pieces of the flues one section is pushed too far into the other, thus restricting the passage of hot air, or again the flue leading to the chimney may be pushed too far into the chimney opening with the same result.

The Type I. furnace is fed by lowering the logs vertically through the stoke hole and allowing them to fall backwards on to the inclined baffle wall. The logs should not exceed 4 feet in length. In the Type II. furnace the logs should lie on the inclined hearth below the stoke hole.

If it is necessary to reduce the temperature it should be done by closing the air vents partially or completely as circumstances require and *not*, except in an emergency, as the average fire boy likes to do, by leaving the stoke hole open. It will be necessary to clear the air inlets occasionally with a small iron rake, but only dead ash should be removed, care being taken not to rake out the live charcoal. At the end of a curing all the ash should be removed from the furnace.

Soon after first lighting the fire, cracks almost invariably develop in the side walls; these should be closed up with "dagga" and will not, as a rule, give any further trouble.

This furnace is not suitable for burning very large logs or large awkward shaped roots.

Later Notes.—Since the above article first appeared in this Journal the writer has had the pleasure of meeting a large number of tobacco growers who have expressed in generous terms their satisfaction with this furnace. The fact that many growers, after giving it a trial, have replaced their other furnaces with it and are also building it in conjunction with new barns, is a very definite indication of its growing popularity.

The following notes may be of general interest as they embody replies to questions which the writer has been asked from time to time.

There appears to be little object in increasing the thickness of the furnace walls from 9 inches to 14 inches as has been suggested, since it is doubtful if the small amount of heat which would be conserved would result in any appreciable saving of fuel, nor would it tend to eliminate the cracking in the external brickwork.

The cracks which appear on the outside of the walls are unavoidable in a furnace of this description, since it is inevitable that the inner layer of bricks must get hotter and will therefore expand more than the outer layer. If the walls are properly reinforced as explained in the text, these cracks will not affect the working of the furnace, unless they extend right through the wall, in which case they should, of course, be filled in with "dagga."

The function of the baffle walls in these furnaces is to prevent ash and unburnt fuel from entering and possibly choking the inlet flue, and also to protect the metal flue to some extent from the destructive effect of the actual flames.

In cases where the outside ground level is appreciably lower than the level of the barn floor and the inlet flue can in consequence be set fairly high up in the rear wall of the furnace, the baffle wall, or rather the space behind the baffle wall, performs no useful purpose and may well be dispensed with. In the case of the Type I. furnace the rear wall would, under these circumstances, be built solid with the stepped hearth and the inlet flue would be set somewhat above the level of the top step. In the Type II. furnace the rear wall would be built immediately behind and solid with the baffle wall, which would remain in the same position as shown in the drawing. It would thus be simply a thickening of the rear wall to withstand the battering it receives when the fuel is carelessly thrown into the furnace. In both these cases the overall length of the furnaces would be reduced by 9 inches.

In cases where it is necessary to retain the space behind the baffle wall in the Type II. furnace, the baffle wall itself may with advantage be made 14 inches thick instead of only 9 inches thick, as shown in the drawing. As a result of this alteration the overall length of the furnace would be increased by 4½ inches.

One instance came to the writer's notice where difficulty was experienced in getting these furnaces to work, owing to the fact that the chimneys extended only a few feet above the top of the furnaces, and were not therefore inducing sufficient draught through the furnaces. The trouble was overcome by increasing the height of the chimneys. As a general rule, in order to ensure a proper draught, the chimneys should extend two or three feet above the gutter or eaves of the barn roof.

Cleanliness Aids Insect Control in Lands and Sheds, Stores and Farmsteads.

Cleanliness Aids Insect Control

SOME EXAMPLES OF AGRICULTURAL HYGIENE.

By M. C. Mossop, M.Sc., Entomologist.

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When the average person first hears the slogan "Cleanliness Aids Insect Control," the general impression gained is something like this: "If I keep myself clean, I won't get lice. If I keep my home and domestic pets clean, I won't get fleas. If I keep my native servants clean, they'll bring fewer bugs into the house. If I keep my kitchen and pantry clean, I'll get fewer cockroaches, beetles and moths." The reason that these ideas are the first to come to mind is that personal and household cleanliness are related to health, and medicine is a very much older profession than agricultural entomology. There are probably dozens of medical doctors to every entomologist. Entomologists have advised cleanliness in relation to individual pests for a good many years, but have not, on the whole, been sufficiently active in stressing it as a general routine on the farm. On the other hand, general cleanliness in the home is drilled into us almost from birth onwards. It is at least as old as Mosaic Law, and probably much older.

But what is the principle underlying insect control by means of household cleanliness, or with its aid? Briefly, it is the removal and destruction of the food upon which the insects live, or alteration of the conditions favourable for their increase. Removal of their food may remove the insects with it, or it may starve them out, or it may render the house unattractive to those insects that tend to come in.

Having once realised why cleanliness aids insect control in the home one need go only a step further to apply the same principles to the farm and garden. But first of all, to

appreciate cleanliness one must know what dirt is. In the house, dirt chiefly consists of small particles of human food or other organic matter, dust of various kinds, and one or both of these incoporated in fluff. A much-debated definition of dirt is "matter out of place." While it is easy to pick holes in this definition, it at least covers the subject even if it is rather sweeping. From the point of view of the farm, "plants or refuse out of place" might be a better definition.

For instance, old maize stalks lying on the lands in late spring constitute dirt. They are agricultural refuse; the cattle are finished with them, and the farmer has finished with them. They will not rot until well after the new crop has been planted, and in rotting at this time they use up nitrogen and will not be of much value as plant food for the new crop. They have their value if collected and included in the compost heap, but then they are no longer out of place and therefore no longer refuse.

Now, the progressive farmer who collects this refuse and rots it receives at least a twofold return. First, he adds to the amount of compost he is making—that is an obvious return. But he also removes from his lands the larvae or pupae of the Maize Stalk Borer(1) that are sheltering in the stalks, and, by means of the heat generated in the compost heap, kills them—that is a less obvious but probably more profitable return. The adult or egg-laying stage of the maize stalk borer is a night-flying moth. The moths emerge normally from the end of November onwards, but earlier when there have been good early rains. Old stalks should, therefore, be disposed of by early November at the latest. A further benefit received is the removal of one of the commonest sources of diplodia.

As most tobacco growers now realise, country-wide winter cleanliness on tobacco lands, with no other known aid, has been successful in controlling Tobacco Whitefly(2) together with the disease, tobacco leaf-curl, which it carries. This cleanliness has been incorporated as a farm routine by the best growers. Sporadic outbreaks are liable to occur, but only one serious such outbreak is believed to have occurred since

(1) *Busseola fusca*, Full. (2) *Bemisia rhodesiaensis*, Corb.

the uprooting of all tobacco stalks and general cleanliness were adopted by the growers. The outbreak referred to was traced to neglected tobacco re-growth. Experience during the last few years indicates that cleanliness not only *aids* control of whitefly, but constitutes the *main controlling influence.*

The control of the three pests of the farm orchard most noticeable to the consumer is a further example of the aid of cleanliness in the form of proper disposal of crop refuse. Naturally, the most generally noticed orchard pests are those seen or tasted when the fruit is being eaten. In Rhodesia these pests are fruit flies(3), vinegar flies(4), and the False Codling Moth(5). Infestation of fruit by insects often tends to make the fruit ripen early or drop to the ground, or both. If these fruits are left, they merely act as a suitable maturing ground for the pests that are in them, and they may give rise to a further generation of pests that can work havoc in the remaining crop.

All infested fruit should, therefore, be collected and buried deeply under well-firmed soil, or preferably boiled or fed to stock that will consume it immediately. Because the larvae leave the fruit in order to pupate in the soil, collection should be frequent, so that the fruit can be destroyed before it is too late.

In sylviculture, cleanliness is often a very useful weapon, and in forest entomology it plays a very important part. The control of the Eucalyptus Borer(6) is an example. The insect is controlled by the removal and early utilisation of all dead and unthrifty trees, by stripping the bark of trees immediately they are felled, and by the use of trap trees. Of these, the part played by plantation cleanliness is at least equal in importance to the other measures.

With many other crops and many other pests, the same principle of control by the destruction of crop refuse applies.

However, old stalks, infested fruit, unthrifty or dead trees, and unwanted re-growth are not the only kind of dirt that may

(3) Fam. Trypetidae.
(4) *Drosophila* spp
(5) *Argyroploce leucotreta*, Meyr.
(6) *Phoracantha semipunctata*, F.

be present on lands or in plantations. When a farmer talks of dirty lands he usually refers to weedy lands. Weeds are merely plants out of place, and the process of getting rid of them is known as cleaning. Weeds support an insect population that is not exclusively their own. Many of the insects that live on weeds are also pests of cultivated crops, and it is therefore necessary to dispose of weeds before they are able to increase their population of crop pests.

Here again matters should be taken in hand before they have gone too far. The destruction of weeds that have been allowed to grow for too long a period may result in the migration of their well grown insect population to the crop. The control of weeds while they are still young is therefore necessary. This might entail extra cultivation, but increased cultivation tends to better soil aeration, and it is becoming recognised that good soil aeration produces healthier crops that are less susceptible to insect attack. Thus again, to direct benefit we may add indirect benefit.

Weeds that are present in the growing season are not the only weeds to be kept under control. Those that are in the lands even after the crop has been harvested are a source of danger to the following season's crops. Some of the weed-eating caterpillar pests of crops continue to breed or grow until well into the cold season. Early ploughing will bury these before they mature, together with their food plants. Once more, the earlier the better, for early ploughing is better ploughing, because the soil is more friable and the weeds are more likely to be properly buried.

In lands infested with Root Gallworm(7) the maintenance of a clean, bare fallow for a year or more reduces the severity of the pest considerably. Better and speedier results would be obtained by constantly turning over the soil during one dry season in order to dry out both soil and plant roots. Fortnightly cultivation has produced good results in the Transvaal.

A further type of dirt or refuse consists of materials that have been harvested with the crop and later discarded or allowed to accumulate. The importance of the disposal of

(7) *Heterodera marioni*, Goodey.

maize cobs and husks, and of tobacco waste, is already recognised. Maize and tobacco are our main crops and have naturally received most attention. Dangers are almost surely present in accumulation of the waste from other harvested crops.

Old maize shelling dumps have been found to be among the more important sources of field infestation by the Maize Weevil(8). Tobacco waste left in or around the grading sheds and curing barns encourages the breeding of the Stored Tobacco Worm(9) and Tobacco Beetle(10). I have spoken and written on this subject before, and will not go into further detail now.

We have yet to touch on the application of cleanliness in the raising of livestock. The best known example is the regular and frequent cleaning of stables and byes, and of styes and kraals, combined with the proper disposal of the manure and bedding. If these are allowed to accumulate they become a suitable breeding place for the disease-carrying House Fly(11). If they are properly attended to by being gathered into a heap and aerated by turning, sufficient heat is generated in the subsequent fermentation to kill the eggs or maggots of flies that attempt to breed in them. When well rotted, they are no longer breeding places for flies. Similarly, heaps of grass left lying around to rot slowly become the breeding grounds of the irritating, biting Stable Fly(12). Such grass should be mixed with the manure to be rotted, or else spread out and dried.

I have attempted to point out some typical cases in which cleanliness aids insect control, or even *effects* control, in field husbandry, horticulture, sylviculture, animal husbandry, and public health. There are more cases of which we know, and almost certainly many more of which we do not know.

For the sake of brevity, I have not made a special point of stressing the fact that agricultural cleanliness is usually little more than the sincere application of sound farming practice advised by agriculturists for purposes other than insect control, and which are believed to be worth their cost

(8) *Calandra oryzae*, L. (9) *Ephestia elutella*, Hubn.
(10) *Lasioderma serricorne*, F. (11) *Musca vicina*, Macq.
(12) *Stomoxys calcitrans*, L.

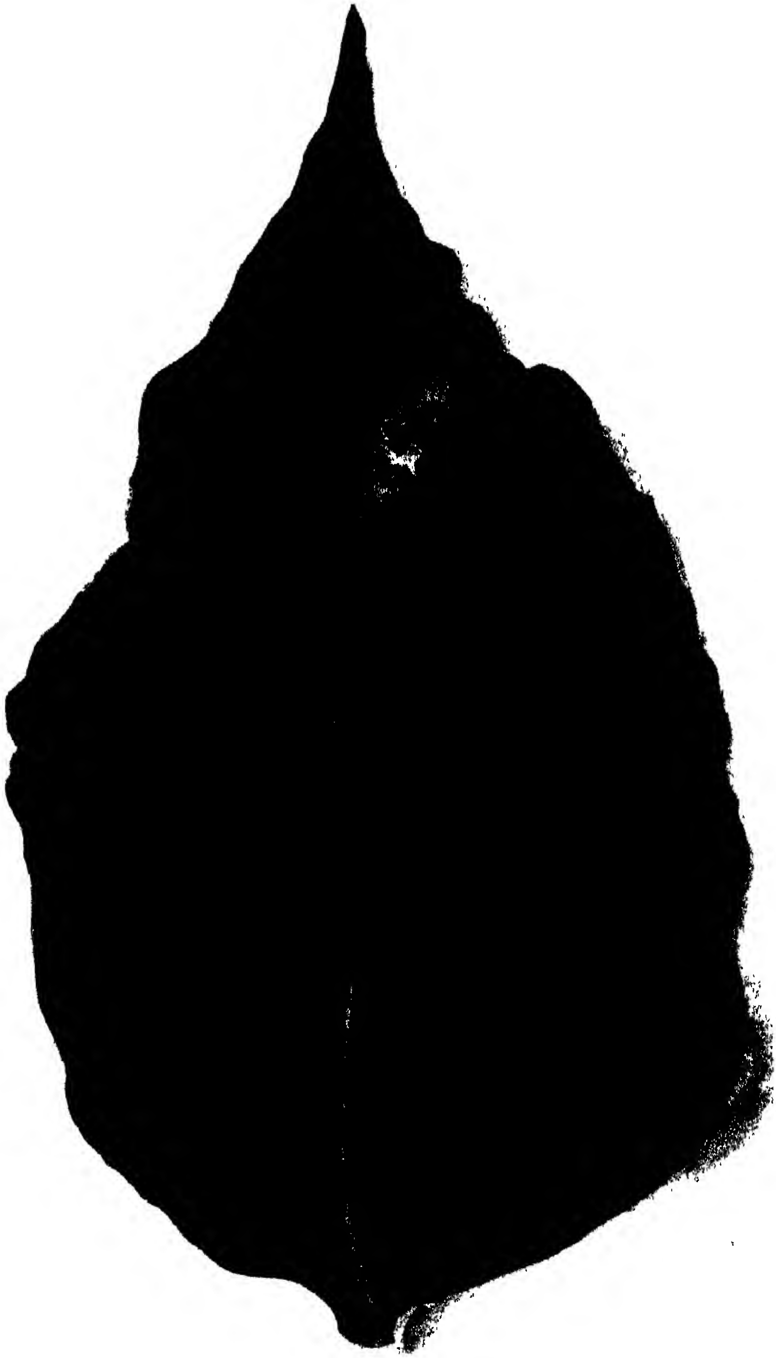
for these purposes alone. It is our good fortune that Nature allows of this co-operation of effort and we should take full advantage of it. We want insect control without the use of special chemicals. In many cases we have it; in further cases we have valuable and inexpensive aids to chemical or other control. Nor have I stressed the assistance rendered by cleanliness in the control of diseases of plants, of animals, or of humans. In fact, the more widely one considers the subject, the greater the benefits appear to be.

I make no attempt to apologise for the subject of my talk, nor for any efforts to further our cleanliness campaign with the aid of the slogan "Cleanliness Aids Insect Control." Locked up in Government safes, the theory of cleanliness is useless; the farmer must be given the key. If the slogan can be popularised and be kept before the public, it should induce sub-conscious thinking, and once we have arrived at that stage, action can follow without effort. Let the slogan "Cleanliness Aids Insect Control" help you to unlock the door to prosperity.

Good night everybody. May you have a Prosperous New Year.

CLEANLINESS AIDS INSECT CONTROL

in Lands and Sheds, Stores and Farmsteads.



BROWN (ALTERNARIA) SPOT.

Diseases of Tobacco in Southern Rhodesia.

(Supplement I. 1932 to 1938.)

By J. C. F. Hopkins, D.Sc. (Lond.) A.I.C.T.A.,
Senior Plant Pathologist.

INTRODUCTION.

In 1931(1) the first handbook on the diseases of tobacco in Southern Rhodesia was published by the Department of Agriculture. Its object was twofold. Firstly, to provide a ready reference for the tobacco grower to the common diseases which attack his crop, and secondly, to conform to a resolution passed at the Imperial Mycological Conference of 1929, that a series of handbooks be prepared on the diseases of crops in various parts of the Empire. In the descriptions which follow, the original publication will be referred to as the Departmental handbook.

Since 1931 many advances have been made in the study of plant diseases, and this is particularly so in the case of virus diseases. Within the last five years the nature of viruses has been discovered and the study of them carried far into the field of physico-chemical science. Our latest knowledge appears to bring us to the very boundary line between the living and the dead, so that we almost find ourselves back in the days of "spontaneous generation."

Our knowledge of the behaviour of tobacco diseases under local conditions has been added to, but it is sad to relate that the actual number of diseases occurring in Rhodesia has also increased.

With growing experience, the majority of tobacco farmers are now adept at diagnosing diseases in their early stages. An increasing number are also adopting spraying both in seed-beds and lands as a general practice, with the result that a distinct improvement in disease control has taken place

during the past six or seven years. It is now no longer a common sight to see whole lands, or even crops, almost completely ruined by such diseases as wildfire, angular spot and brown (*Alternaria*) spot. These diseases still occur and are always likely to occur, but it has been found in almost every case that, if tackled in their early stages, they may be kept under reasonable control.

Although it has been demonstrated over and over again that suitable priming, aimed at preventing spore formation by the fungus, is a satisfactory way of keeping frog-eye in check, there appears to be no appreciable reduction in the average yearly damage done by this disease. In their consideration of the economic aspect of tobacco production, the majority of growers still appear to be unaware of the enormous losses which they suffer from the various phases of the frog-eye disease. There is no doubt that, under normal market conditions, the tobacco industry loses not less than £100,000 annually as a result of frog-eye field spot and barn spot.

It must be admitted that distinct advances have been made in recent years in the control of this disease in seed-beds and young transplants, but the good that has thus been done is in so many cases vitiated by partial neglect of the crop at its most critical stage, just before it commences to ripen. The whole matter of frog-eye control will be dealt with in a later part of this Supplement.

An innovation which appears to have come to stay is field spraying. Some form of dusting or spraying has been practised in other tobacco growing countries for some years past, but this has been aimed almost entirely at insect pests such as the hornworm, in America, and aphis (green fly) in, say, Nyasaland. The use of fungicides in the field to control leaf spotting diseases does not appear to have been given much attention.

As a result of experimental trials and farm experience during the past ten years, there is sufficient evidence to show that field spraying in some form or other is an economically profitable operation, so much so that a separate section of this Supplement will deal with the subject.

A branch of science which has progressed considerably in recent years is that which deals with nutritional diseases. For many years tobacco has been used as a medium for the investigation of plant nutritional problems, owing to its sensitivity to excess or deficiency of plant "foods," particularly the mineral constituents. Despite this, newly observed nutritional disorders continue to appear, and it is to be hoped that continued investigations on physiological lines will eventually solve the problem of flavour, "tang," texture and the many other empirical qualities so dear to the manufacturer.

Under the heading of nutritional diseases, certain amendments are made to the original text.

In order that this Supplement may be more easily read in conjunction with the original handbook, the same order of presentation is retained. Thus under the heading of "Nature of Plant Diseases" some remarks are made on the modern conception of viruses. In the same way, notes are given on some practical ways of overcoming certain seed-bed troubles under the heading of "Plant Sanitation and Care of Seed-beds," and so on. It is hoped that in this way the improved methods of disease control which have been evolved may be brought to the notice of all tobacco growers in Rhodesia.

NATURE OF PLANT DISEASES.

In recent years the general conception of the nature of plant diseases has undergone some changes. Particularly is this so in the case of nutritional disorders and virus affections. Further knowledge has also been obtained on the relationship existing between parasitic organisms and environment.

A good many troubles which at one time were vaguely attributed to physiological diseases have now been traced to specific deficiencies or excesses of minerals which are normally present in the soil in very minute quantities. A deficiency of boron has been shown to produce a disease of citrus causing wilting of trees, die-back of twigs and the development of hard, thick-skinned fruit lacking juice. A good many diseases of other crops have also been traced to boron deficiency. Abnormal plant development may also be brought about by

the absence of sufficient quantity of copper, zinc, phosphorus, iron, magnesium, potassium and other elements in the soil.

Disorders may also be induced by an excess of certain elements, as for instance manganese, thallium, molybdenum, chromium, chlorine, potassium and so on.

The exact part played by these substances in plant nutrition is not as yet fully understood, but it would appear that unless they are present in certain concentrations, the plant is unable to take up its normal chemical requirements from the soil and metabolism is impaired.

There seems to be little doubt that the stimulus which these diseases have given to plant physiological research will before long result in a very much clearer understanding of the intricate working of plants in general and of crop plants in particular.

Another conception which has recently been revived is that diseases as we know them are not in reality diseases, but symptoms of malnutrition or some other disorder in the plant. In other words, some internal trouble, caused by erroneous methods of cultivation, is the true disease, and that the presence of a parasitic organism is merely a contributory factor in the production of certain symptoms which are now regarded as diseases. In a great many instances this is, of course, true. Without certain adverse environmental influences a good number of diseases fail to develop despite the presence of a parasite, but in the vast majority of cases where parasitic fungi or bacteria are concerned, infection does take place, although the disease may not become epidemic. It is held by some that this resistance on the part of the plant is the result of increased "stamina" induced by a favourable environment and that this stamina can be maintained by suitable methods of cultivation. Again, this is in part true, but in order to guarantee freedom from disease in any crop, it would be necessary not only to control nutrition, but also climate, for probably the principal factors influencing the development of plant diseases are rainfall and temperature.

On the other hand, of course, resistance to disease can be bred into crop plants and numerous resistant varieties of all kinds are constantly being put on the market, but in so

many cases resistance is due to some physical attribute which is inherited and is not necessarily produced by improved nutrition.

This does not mean to say that nutrition plays no part in the plant's reaction to parasitic organisms. On the contrary, such diseases as wildfire, angular spot and frog-eye in tobacco are influenced to a large extent by nitrogen balance. From the practical point of view, in the control of plant diseases, it matters not whether a parasite be regarded as a cause of disease or merely a contributory factor. It is only possible at the present stage of civilisation to control climate by choosing suitable planting seasons and latitudes, and no one has as yet evolved methods of cultivation which will immunise crops against all diseases. Until such time as crops are raised on ideally balanced culture media under conditions of controlled temperature and humidity, the necessity for plant sanitation and the removal of plant parasites will remain.

The really great advance that has been made in recent years in the study of plant diseases is the discovery of the nature of viruses. There seems to be no doubt now that viruses are of the nature of proteins which can be isolated from juice extracts of plants in the form of crystals. To tobacco goes the honour of first revealing this secret to mankind.

Workers in America and Europe have purified the crystals of tobacco mosaic, stored them in bottles for many months and then reproduced the disease in healthy tobacco plants by inoculating them with a solution of the crystals in water. Where viruses differ from the substances normally regarded as proteins is in their ability to multiply in living tissue. This suggests some form of life, and this recent discovery has given a tremendous impetus to research on viruses, particularly in regard to their molecular structure. For it appears that viruses may be built up or broken down in the same way as other substances in a plant or animal, which may account for the appearance of numerous strains of a virus having different powers of reaction, and may also account for the apparent production *de novo* of new viruses.

There are a great many problems regarding viruses still awaiting solution such as why some can be transmitted from plant to plant by juice inoculation, whilst others can only be transferred by means of a specific insect. Thus mosaic is highly infectious by contact whilst leaf curl depends on white-flies for its dissemination.

It will therefore be seen that the nature of plant diseases is being brought under the searchlight of modern enquiry, and it is hoped that continued research will produce vastly improved methods of disease control in the not too far distant future. Until that time arrives commonsense hygiene and field sanitation must continue to play a most important part in the production of crops.

PLANT SANITATION AND CARE OF SEED-BEDS.

The importance of paying particular attention to the raising of disease-free plants in the seed-beds has been stressed on many occasions in the past. The same injunction is of equal importance to-day. A big step is made towards the production of a first class crop, if healthy, vigorous seedlings are used for planting. The successful growing of clean tobacco depends very largely on keeping the plants growing ahead of disease, so that reaping commences before any serious inroads have been made. Provided that the lands are uncontaminated, clean seedlings ensure a healthy stand of well grown plants being established before air-borne diseases such as frog-eye and brown spot find their way to the crop. If, however, seedlings affected by frog-eye, angular spot or wildfire are used, there is always the danger of an epidemic occurring under conditions favourable to the diseases. In fact, raising a paying crop from diseased seedlings is always a gamble, and is a source of continual anxiety, if not always financial loss, to the grower.

Preparation of Seed-beds.

The necessity for the selection of a well-drained site is referred to under diseases such as "damping-off" and black stem rot, but it is unwise to choose soil which has not a good waterholding capacity in order to ensure good drainage. It is found that certain types of soil bordering on vleis are

sometimes utilised for seed-beds. These soils have usually been subjected to considerable erosion and are deficient in humus and organic matter generally. They do not retain moisture at all well, so that it is often necessary to water them almost continually in order to prevent the seedlings from wilting. Plants grown under these conditions are pale or yellowish in colour and very susceptible to frog-eye.

Sandy soils deficient in humus are also reported in America[2] to accentuate chemical poisoning in tobacco, and cases of chlorine toxicity have been encountered in Rhodesia in seed-beds of this type although the chlorine content of the soil was only about fifty per cent. above normal.

Seed-bed Sterilisation.

Although it is realised that seed-bed sterilisation is a laborious operation, yet the necessity for eradicating certain plant pathogens remains. Soil sterilisation is aimed at killing the fungi which cause "damping-off," black stem rot and so on, as well as the more serious root nematode.

It is held by some growers that the application of organic manure, preferably in the form of compost, to seed-beds will immunise the plants against all ills. This theory results from a confusion of ideas and from false analogy with diseases of animals and man. Certain plant diseases such as frog-eye, brown spot, angular spot and wildfire are regarded as symptoms of malnutrition and it is thought that they are brought about by an execssive use of artificial fertilisers. The fact that these diseases are caused by parasitic organisms is unfortunately overlooked, and although plants raised on a balanced nutrition are, generally speaking, more resistant to diseases than those of lesser stamina, the mere substitution of manure for other forms of fertiliser does not confer complete immunity.

If seed-beds are used continuously or inalternate seasons, the possibility of infection being present when beds are sown is high, unless some precautions are taken. This particularly applies to those diseases already mentioned which come from the soil and are caused by normal soil-inhabiting organisms. It is because experience has shown that considerable trouble may arise from this source that soil sterilisation is advocated.

Various methods are employed in different parts of the world, but some form of heat is found to be the most efficacious. Steaming is the most satisfactory under certain conditions, for if done efficiently not only are the plant parasitic organisms destroyed but the fertility of the soil is increased.

In Rhodesia, steam heat has not been adopted, but the open fire method is in common use and when employed by experienced growers is found to give very satisfactory results. Fertility of the soil is not lost provided that over-burning does not take place. After sterilisation, manure in the form of well rotted compost is safe to add to the beds, if it is known that the compost does not contain tobacco refuse. Although, theoretically, parasitic fungi should be killed by the heat of composting, it is known that some plant pathogens do survive. The probable explanation of this fact is that small pieces of infected plant débris never reach the interior of the heaps or pits and are not subjected to lethal temperatures. Very minute particles of plant tissue containing an active parasite are all that are required to start up a disease.

The manure should be dug well in and the beds levelled off leaving the surface somewhat rough in order to prevent seeds being washed together during watering. If beds are left smooth, and especially if the soil is deficient in organic matter so that the surface is composed largely of sand particles, considerable losses of seedlings may be experienced at the time of germination. A common complaint is that when the seed coat splits, the minute root pushes up into the air, shrivels and dies. This is caused by its inability to push downwards owing to the presence of a hard surface due to excess of sand and deficiency of soft humus into which it can penetrate.

When this trouble is experienced, if taken in time, the plants may be saved by applying to the beds a thick suspension of antheap soil in water. If immediate action is not taken when the seedlings commence to die, the bed may be lost and have to be re-sown.

Other methods of sterilisation against "damping-off" fungi have proved successful where heat sterilisation has not

been employed, but the use of chemicals as a substitute for heat is a retrograde step and is not recommended. In cases of emergency when plants are dying in large numbers, it is found that applying dry Bordeaux powder to affected patches checks the disease. As a preventive form of sterilisation if "damping-off" is expected to occur, the beds may be watered every four or five days with Cheshunt Compound, which is prepared in the following manner:—

Take 2 ozs. copper sulphate (bluestone),
11 ozs. ammonium carbonate.

Grind each separately—especially the ammonium carbonate—to a fine powder and mix intimately. Place the mixture in an air-tight glass or earthenware container for at least 24 hours, when it will take on a deep royal blue colour.

Weigh out 2 ozs. and dissolve in a little hot water. Bring up to 4 gallons (1 petrol tin) with cold water.

This solution may be watered on to very young seedlings without risk or damage and can be used at double strength on less delicate plants.

Difficulty may be experienced in crushing the ammonium carbonate, which is usually bought in hard lumps. A satisfactory powder can, however, be obtained by the use of a prospector's pestle and mortar.

Seed Treatment.

Since the publication of the Departmental handbook, silver nitrate has superceded corrosive sublimate as a disinfectant for tobacco seed. The sterilisation of seed has become almost universally adopted by growers in the past few years and the benefit to be derived can be assessed by the comparatively rare appearance of either wildfire or angular spot in seed-beds.

Directions for Use.—17½ grains of silver nitrate should be dissolved in two pints of clean, cold rain water or distilled water, or tablets may be obtained which, when dissolved in a pint of water, give the required dilution, namely, 1 in 1,000.

The seed to be treated should be tied loosely in a piece of muslin and soaked in this solution for 15 minutes, with

frequent agitation. The seed and muslin should then be removed, drained and washed well in clean running water for several minutes or in five or six changes of water.

The seed should then be spread out in a suitable receptacle and dried rapidly in the sun, with occasional stirring. It is advisable to place the seed whilst drying in a place sheltered from the wind owing to the ease with which a sharp gust can scatter it.

When thoroughly dry the seed should be poured into clean calico bags and stored away from any tobacco refuse, such as is found in grading and bulking sheds.

The drying can be obviated by treating the seed and then sowing by the water-can method after it has been thoroughly rinsed. The treatment should not be done down at the seed-beds owing to the danger of untreated seeds being dropped and producing infected plants which would soon spread disease through all the beds.

SPRAYING.

Many changes have taken place during the last few years in the methods and materials used for spraying seed-beds, so that some modifications of the recommendations made in the Departmental handbook are necessary.

Two kinds of copper spray are usually employed, Bordeaux mixture and colloidal copper. Several makes of proprietary Bordeaux mixtures are obtainable locally, but the best results have been given in trials by the brands in which the copper sulphate (bluestone) and lime are packed in separate air-tight cartons. When freshly made these are as efficient as home-made Bordeaux, but nearly twice as costly.

Used at the 4-4-50 concentration, one gallon of the spray fluid per 25 yard bed is found to give protection against frog-eye, angular spot and wildfire.

Colloidal copper has recently become popular largely owing to the facility with which the spray fluid can be prepared. Used at a concentration of 5 lb. per 100 gallons of water (1 whisky bottle to 40 gallons water) plus a good

spreader, it has been found to prevent infection of beds by the same three diseases(3).

For those growers who wish to economise on their spraying costs, the following method of making Bordeaux at home is given.

The equipment required is:—

(1) Two forty or fifty gallon drums. If made of iron, they must be painted inside with a bitumen compound to prevent deposition of copper on the iron.

(2) A piece of hessian and a long stick to go across one of the drums.

(3) Some doubled cheese cloth to strain the spray fluid.

(4) A tin or similar container in which to slake the lime.

The most important part about making Bordeaux mixture is that first quality, freshly burnt lime *only* must be used. This can be obtained in various ways, but not by ordering a sack from a dealer, because by the time the sack reaches the farm, if it has not completely disintegrated beforehand, all the lime will have slaked and no unslaked lumps will be found.

It is possible to purchase specially selected lumps of burnt lime from some dealers at a cost slightly in excess of the normal price. These should be put into an air-tight drum, despatched to the farm and kept until required for use.

To prepare the spray, 25 gallons of water should be poured into one of the drums; 4 lb. of crushed bluestone (copper sulphate) crystals should then be tied in a piece of hessian and suspended from a stick placed across the top of the drum, so that the bag is just immersed in the water.

Four pounds of unslaked lumps of lime should be placed in a petrol tin and sprinkled with water until the lumps commence to crack and a good heat is generated. Water should be continued to be added in small quantities so as to keep the reaction progressing rapidly, but care must be taken not to add so much water that boiling ceases and the lime

becomes wet. If properly prepared the finished product should be a fine dry, white powder free from lumps. The operation is very simple and takes only a short time.

The lime should then be added to 25 gallons of water in the second drum, the suspension being stirred well. A sack should then be placed over the top of the drum to exclude air, and the lime water left, with occasional stirring, for an hour (or whilst breakfast is being taken).

Immediately before spraying commences the bluestone and lime solutions should be mixed by slowly pouring the lime water, through a doubled piece of cheese cloth, into the bluestone, stirring all the time.

Spreader (according to manufacturer's directions) should be mixed to a paste with a little water and added to the Bordeaux mixture, which is then ready for use.

In view of the utility of knapsack spray pumps and their suitability for use in the field, it is recommended that these machines be used on seed-beds. They should be worked at a good steady pressure and the nozzle held at least two feet above the plants. Provided a nozzle giving a fine mist-like spray is used, excellent cover of the foliage will be obtained in this way and at the same time a minimum amount of spray fluid used.

Many growers still prefer to use a bucket pump for seed-bed spraying. In order to facilitate the work, the pump is equipped with from 20 to 30 feet of ⅜ inch hose, so that two adjacent beds can be sprayed without the necessity of constantly moving the bucket.

Nozzles of the whorl type are in general use now, but a few growers persist in the use of the old-fashioned tap type, which goes under the misnomer of "Bordeaux Nozzle." It is an efficient implement for washing motor cars, but of little good for use on tobacco seed-beds.

Various modifications of the spray fluid are in common use, reference to one of which has been made in the section dealing with rosette disease. As a general spray, Bordeaux should be used in conjunction with arsenate of lead at a strength of 1½ lb. of powder to 50 gallons spray, in order to eliminate stem borer and control cutworm.

Plate 9 Fig. 20.—Spraying in the lands against wildfire with knapsack pumps The nozzles are held high above the plants

Plate 9 Fig. 21.—Uneven coating of spray on seedlings resulting from the use of a coarse nozzle and low pressure.

Spraying should be done once every five days so that all newly unfolded leaves may be protected. This usually involves five sprayings per bed. The final spraying should be given the night before transplanting, if this can be judged, or, alternatively, the plants should receive a good covering immediately before they are pulled.

If spraying is done conscientiously and regularly from the time the first leaves of the seedlings are the size of a shilling, until they are put out in the lands (not omitting to spray whilst hardening off), it is a simple matter to plant a land with 100 per cent. healthy plants.

Field Spraying.

An innovation which gains more popularity each season is spraying in the field. This has been dealt with from time to time in the *Rhodesia Agricultural Journal*, but no regular type of equipment or standard procedure has as yet been adopted. The greatest success has so far been obtained by the use of Bordeaux mixture applied by means of knapsack pumps (Pl. 9, fig. 20).

It must be stressed that field spraying was originally recommended in the Departmental handbook for the control of angular spot alone, and was not put forward as a control measure for other diseases, particularly frog-eye. It has, however, been found that both wildfire and brown (*Alternaria*) spot can be controlled by the use of fungicides in the lands, but spraying must be combined with priming and carried out wholeheartedly if success is to be attained.

Equipment.—For wet spraying, knapsack pumps are recommended. If fitted with fine nozzles they are found to be very economical, and the freedom of movement given to the boys allows them to apply a good covering of fungicide to the plants without waste of time. Furthermore, the pumps can be used for spraying seed-beds.

Wheeled equipment has been used by a number of growers and has been found to be fairly satisfactory, but difficulty is usually experienced in devising a suitable cart with only a 3 foot track (the width between the rows of tobacco) which is not top-heavy when loaded with a drum of

spray fluid. If a wider track (say 6 feet to span two rows) is employed, it is found that the wheels ride up on the ridges and damage several plants before they return to the furrows. However, some growers are using wheeled equipment fitted with six nozzles and leads, each of which is operated by a boy following the cart. Thus six rows at a time are sprayed.

It is suggested that every tobacco grower should be in possession of an emergency spraying outfit consisting of one knapsack pump to 20 acres of tobacco and a supply of either Bordeaux mixture or colloidal copper in air-tight containers.

Method of Procedure.—If a sudden outbreak should occur of wildfire, angular spot or brown (*Alternaria*) spot, a survey should at once be made of the whole crop and the infected area demarcated. All spotted leaves should be removed from infected plants, placed in sacks, taken from the field, and destroyed. Where infection is severe on young plants, the leaves should be stripped off to the bud.

The stripped plants should then be sprayed from fine nozzles, held about 2 feet above the plants, with Bordeaux mixture 4-4-50 or colloidal copper 5 lbs. to 100 gallons, and spraying should be continued every day until the disease ceases to reappear. At the same time freshy infected leaves should be primed off and carried from the lands to be destroyed.

Spraying of large plants is not recommended owing to the danger of the fungicide adhering to the mature leaves when reaped. Experience has shown that if field spraying and drastic priming are carried out sufficiently early, elaborate control measures are seldom necessary in the later stages of the crop.

With knapsack pumps it has been found that 4 boys working continuously, or between showers, can spray thoroughly 10 acres a day, using only about 10 gallons of spray per acre, and at this rate large areas can be treated before the disease has a chance to develop on newly formed leaves. If, therefore, as in the case of wildfire, fresh infection occurs after the first spraying, a second can be given before any serious damage is done.

Plate 1 Fig 1.—Damping-off of seedlings caused by black stem rot fungus. Compare with fig 2

Plate 1. Fig. 2.—Usual appearance of damping-off after dead areas have died out.

Numerous reports have been received of the complete elimination of angular spot from heavily infected crops by stripping off leaves and spraying once. In the case of wildfire, successive sprayings have usually been found to be necessary if continued wet weather is experienced. In such cases it is estimated that the cost of controlling an outbreak in 100 acres of tobacco is unlikely to exceed £30.

Whether field spraying will be adopted as a routine practice similar to priming and topping remains to be seen, but there is no doubt as to its efficacy in reducing heavy losses from angular spot, wildfire and brown spot, if the work is carried through efficiently and wholeheartedly.

Only pumps capable of working at a good pressure and nozzles of the whorl type should be employed. A uniform covering by the fungicide and penetration into crevices is most important. What happens when coarse nozzles and low pressure pumps are used is shown in Pl. 9 fig. 21. The spray settles on the leaves in drops, so that much of the leaf surface is left unprotected.

It should be added, that it has not been found to be necessary to spray the under sides of leaves.

FUNGUS DISEASES CONFINED TO SEED-BEDS.

"Damping-off" (*Pythium debaryanum* Hesse, and *P. ultimum* Trow).

Both have been isolated from seedlings. *P. debaryanum* has globose sporangia from 15 to 26 microns diameter and discharges zoospores after 18 to 24 hours in sterile water. Oospores globose, smooth, 15 to 18 microns diameter. Antheridia paragynous. *P. ultimum* has similar sporangia, 14 to 26 microns diameter, but zoospore discharge was not observed, germination being direct. Oospores smooth 16 to 18 microns. Antheridia paragynous.

Description.—"Damping-off" is not of very frequent occurrence in Rhodesia, but may appear in any seed-beds. The first indications to the grower are usually circular patches of dead and wilting plants, which later on shrivel up to form light coloured papery sheets of plant tissue as shown in Pl. 1 fig. 2.

By the time these patches appear, the disease has progressed far, the early symptoms being inconspicuous. "Damping-off" is caused by several soil-inhabiting fungi, one

of which, *Rhizoctonia solani*, has already been referred to in the Departmental handbook. Since 1931 two others, namely, *Pythium debaryanum* and *Pythium ultimum*, have been found to produce the disease in Rhodesia. These fungi do not confine their attention to tobacco alone, but are well known to attack all manner of seedlings in most parts of the world.

Early infection takes place in the stems at soil level. The fungi penetrate the outer skin to produce a depressed, soft brown spot. This spot extends vertically and laterally, so that before long the delicate tissues of the young stems are killed and the plants wilt and topple over. The fungi continue to grow in the stem and leaves of the seedlings reducing them to a slimy, shapeless mass upon the ground. As the decomposing plants dry out they take on the appearance shown in Pl. 1 fig. 2.

They differ from the black "damping-off" caused by the stem rot fungus, *Pythium aphanidermatum* (Pl. 1 fig. 1) which is a more serious disease by virtue of its ability to cause considerable loss after transplanting. The two species of *Pythium* now under consideration are not known to affect plants in the field in Rhodesia.

Conditions favouring the disease.—"Damping-off" as the name implies, is a disease associated with excessively wet conditions. When humidity is high and ventilation poor, "damping-off" fungi develop rapidly, so that sometimes during spells of very wet weather large patches or whole beds of plants may be killed in a day or two.

Control.—Control measures should be aimed at reducing humidity as much as possible by watering less frequently and, in the case of grass shade, raising the seed-bed covering to allow of more generous aeration. If, as occasionally happens, persistent early rains are experienced before plants are ready to put out, then it is advisable to treat infected patches and the soil surrounding them with dry Bordeaux powder sprinkled over the surface of the ground. Usually the routine Bordeaux spray holds "damping-off" in check, but where this is insufficient, the dry powder will be found to yield successful results.

It is very rarely necessary to treat the beds by the usual formalin method.

PARASITIC DISEASES IN THE FIELD.

Fungous Diseases.

Brown (Alternaria) Spot (*Alternaria longipes* (Ell. & Ev.) Tisd. & Wadk.).

Conidiophores effused, amphigenous, geniculate, constricted at septa, basal cell swollen, more or less torulose above, 25 to 65 x 5 to 6 microns. Conidia on leaf, obclavate, 3 to 7 septate, 35 to 50 (90) x 8 to 15 microns, with a distinct beak 6 to 46 microns long, borne in short chains. (Conidial length exceeding 50 microns due to excessive length of beak.) In culture, conidia obovate 2 to 5 septate, 12 to 35 x 8 to 16 microns, with short beak 3 to 9 microns long, borne in long chains.

This disease, which is known in Rhodesia as *Alternaria* and in America as brown spot, was only mentioned in a cursory manner in the Departmental handbook. At the time of issue of the publication only one authentic record of the disease had been received and the fungus was referred to *A. tabacina* (Ell. & Ev.) Hori. Since 1931 brown spot has spread throughout the Colony, despite all efforts to keep it in check, but still appears in its most severe form on the red soils of districts of the middle veld.

In recent years severe epidemics have occurred in the Banket, Sinoia, Glendale and northern Lomagundi areas.

In the appendix of the Departmental handbook consideration was given to species of *Alternaria* reported from tobacco. Two species were recorded from Rhodesia, namely, *A. longipes* (Ell. & Ev.) Mason and *A. tabacina* (Ell. & Ev.) Hori. Independently and concurrently, other workers had been studying *Alternaria* sp. from tobacco, and coincidentally with the publication of the Departmental handbook there appeared two papers by Tisdale and Wadkins(16) and Gulyás(17) respectively on *A. longipes* and *A. tabacina*.

There is no doubt now that the fungi dealt with by Tisdale and Wadkins, and Gulyás, are identical with that which attacks tobacco in Rhodesia. Tisdale and Wadkins have shown that their fungus and type material correspond closely to those described by Ellis and Everhart for *A. longipes* and have therefore recommended the use of this name for the fungus causing brown spot. A comparison of disease symptoms and the spores from leaves and cultures shown in my fig. 36 of the Departmental handbook, with those given by Tisdale and Wadkins in fig. 4 leaves no doubt in my mind as to the identity of the organisms, so that I have decided to adopt the binomial *A. longipes* (Ell. & Ev.), Tisd. & Wadk. for the Rhodesian brown spot fungus.

A. longipes (Ell. & Ev.) Mason, described as causing Early Blight on tobacco has not been encountered again by me. There is little doubt that it is a strain of *A. solani*, or at least a member of the *A. solani* group, so that it would appear to be desirable to use the latter binomial for the fungus, and I propose to drop the name *A. longipes* (Ell. & Ev.) Mason.

Description.—The disease appears first on the lower leaves as small, circular, dark brown spots on good bodied leaf, but may be quite light in colour on very bright, thin leaf. The spots enlarge to about a quarter of an inch in diameter whilst retaining their circular shape, and may then be surrounded by a narrow border of bright yellow tissue, especially if the affected leaf is of a deep green colour. (See frontispiece.)

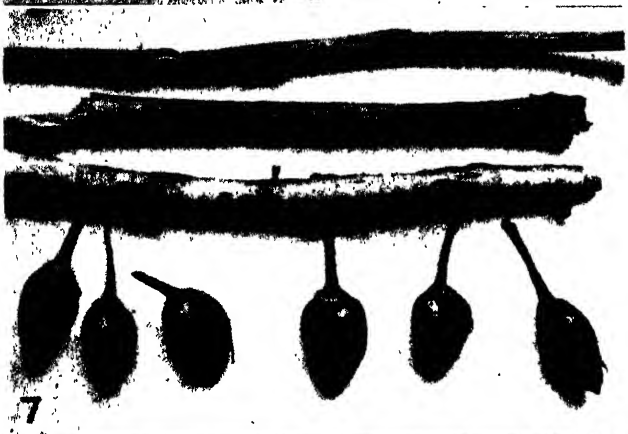
Later the spots may enlarge to an irregular shape or may retain their circular form. At this stage there generally appear concentric rings, or zonations, in the dead tissue and a broad ring of bright yellow round the spot. Under favourable conditions these large spots may coalesce to reduce the whole leaf to shreds and the disease spreads to the top of the plant, so that an uncontrolled epidemic may destroy two-thirds or more of an entire crop.

On very light leaf the disease usually takes the form of circular spots, not more than a quarter of an inch across. These are medium brown with lighter centres, which may eventually become almost white so that they closely resemble the lesions of frog-eye.

The diseases can, however, be distinguished by the presence of numerous minute dark brown or black spots on the stems, midribs, flower stalks and capsules of plants affected by *Alternaria*. They are illustrated in Pl. 3 figs 6 and 7.

When the leaf spots have reached a prominent size, if they are examined closely, they will be seen to possess in their centres a covering of very dark brown, almost black powder. With the aid of a handlens this powdery substance is seen to be a collection of felt-like hairs covered with a dark, dusty mass of spores. When these are enlarged just over 400 times, they appear under the miscroscope as shown in Pl. 3 fig. 8.

When considering control measures, it will be well to bear in mind that any one of these spores is capable of starting up the disease on a clean plant. There may be present between six and seven thousand spores to the square inch on the average leaf spot.



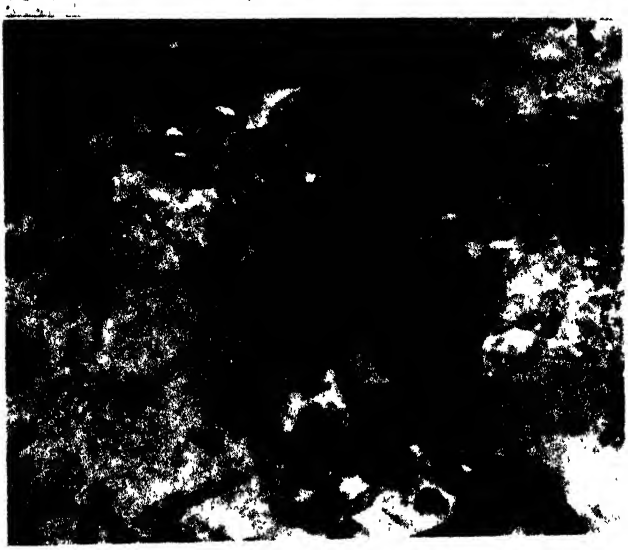


Plate 3 Fig. 6.—*Alternaria* spots on midrib of leaf.

Plate 3 Fig. 7.—Brown spot lesions on flower stalks and seed capsules.

Plate 3 Fig. 8.—Spores of *A. longipes* (Ell. & Ev.) Tisd. & Wadk. on surface of leaf spot. x 420.

Brown spot can also be destructive in the barns. In the early stages of curing the fungus in the leaf spots becomes active, extending into the previously undamaged tissues, where it causes a brown discoloration somewhat lighter in colour than the original lesion. Thus a field spot no more than a quarter of an inch in diameter may be enlarged to as much as an inch across. In addition, new spots may be produced by spores which germinate on clean areas and invade the cells of the leaf, in a manner similar to that adopted by the frog-eye fungus. The spots thus formed, however, are brown in colour and not black as in the case of the latter disease.

Conditions favouring the disease.—The most obvious condition which favours the disease in Rhodesia is high atmospheric humidity with frequent rains. Temperature is also an important factor as shown by Tisdale and Wadkins([16]) in America. Relatively high temperatures, above 80° F., produce the disease in its severest form, whilst temperatures below 75° F. tend to prevent the disease becoming epidemic. These facts explain why brown spot develops more readily on crops grown in the lower lying areas than in those at high altitudes.

It has also been found in Rhodesia that heavy-bodied leaf is more susceptible than bright, and the most severe epidemics have occurred on the red soils of Lomagundi and Glendale. Experimental inoculations of fire-cured (Western) tobacco grown on red soil at Salisbury, have also produced very severe infection, whereas the same culture of the fungus sprayed on to the flue-cured Orinoco White Stem variety growing in sandy loam in the same experimental layout caused the disease to appear in mild form. Identical results were obtained with a culture of *A. longipes* obtained from Nyasaland.

Control.—Field experience has shown that satisfactory control depends on doing everything possible to prevent spore production by the fungus whilst the plant is still actively growing. If the disease becomes widespread before topping takes place, there is every chance of a severe epidemic occurring. Likewise, if spots are allowed to become numerous on the lower leaves, it is certain that the disease will spread rapidly up the plants and do much damage before reaping commences.

Two methods of control are now in operation, namely, suitable priming, and field spraying or dusting.

Priming must commence as soon as the disease makes its appearance. It is of utmost importance that spotted leaves be removed before *Alternaria* spores are produced in abundance. A sharp lookout should be kept for the first appearance of the disease and as far as possible every infected leaf removed from the land. These leaves should be destroyed by burying and not thrown into the bush, as sometimes happens.

In conjunction with priming, it is found to be necessary in some districts to protect the clean leaf by some fungicide. Copper-lime dust has been employed successfully by some growers, whilst others prefer to use Bordeaux mixture. Whatever choice is made, the spray or dust must be applied whilst the plants are still young, and, if conditions are very favourable to the spread of the disease, successive applications must be given. The point to remember is that whatever form of control is practised, it is essential that the work be done wholehearterdly. Brown spot can be, and is being, controlled each season by growers who have learnt by dire experience the importance of early diagnosis and rapid action. In fact, priming and destroying the first infected leaves together with wet or dry spraying in the field has become a successful routine practice with growers in certain districts.

There are other phases of the disease which need to be considered. It has been mentioned earlier that stalks and seed pods as well as leaves may be affected. The fungus attacks the former producing small, round or elongated, very dark brown, depressed spots. At the end of the season, after reaping is finished, the spots may be present in very large quantities. If stalks thus affected are allowed to remain lying about on the ground or in heaps at the edges of lands, the fungus is enabled to hibernate in the dried-out, infected tissues. As soon as rain falls, the fungus becomes active and spores are produced in abundance on the surface of the spots, constituting a dangerous source of primary infection for the new crop.

It is, therefore, most necessary that all old stalks and primings be destroyed as soon as possible after reaping is completed. If the crop residue is ploughed in, care must be taken to see that all stalks are turned under, or, if utilised for making compost, it is vitally necessary that the tissues are decayed right away before the compost is spread out on the farm. It is not yet certain that *Alternaria* is entirely killed in three months' composting.

Gulyás[17] has reported that brown spot is a seed-borne disease in Rumania. That seed capsules are attacked has also been shown in Rhodesia. But under local conditions where all seed heads are bagged early in the season whilst the plants are still in flower, the possibilities of infection are almost negligible. In any case, if seed treatment is practised, there does not appear to be any reasonable possibility of the disease being transmitted by this means. In support of this opinion is the fact that *Alternaria* has not as yet been recorded from seed-beds in Rhodesia.

To the continued in the February issue, when the following will be dealt with:—

Mildew or White Mould, Frog Eye, Brown Stem Rot, Black Stem Rot, Mosaic, Rosette, Leaf Curl, Nutritional Disease, Diseases of Curing and References.

Reprints of the complete supplement will be available from the Department of Agriculture, price 1s., as from the middle of January.

Rhodesia Weather Bureau.

NOVEMBER, 1938.

Pressure.—Mean barometric pressure was slightly above normal.

Temperature.—Mean temperatures were mostly about normal, but some stations in the south were below by reason of lower maximum temperatures than usual.

Rainfall and Weather.—The rains during the month were mostly of the scattered thunderstorm type. Hence a large number of stations received little rain while a few were well above the average.

A notable occurrence was the onslaught of Polar air about the middle of the month, producing an unusual cold spell. It also interrupted the supply of moist air which might otherwise have given rise to good rains.

PRECIPITATION.

Station.	Inches.	Normal.	No of Days.
Beitbridge	0.82	2.06	4
Bindura...	1.71	3.21	8
Bulawayo	3.78	3.23	10
Chipinga	2.54	4.33	11
Enkeldoorn...	4.24	3.55	10
Fort Victoria	1.56	2.86	9
Gwaai Siding...	1.91	2.79	5
Gwanda	2.73	2.37	8
Gwelo	6.57	3.70	14
Hartley	3.11	3.76	11
Inyanga	3.16	3.92	12
Marandellas	4.17	4.09	8
Miami	1.12	3.25	8
Mount Darwin	0.74	3.34	5

Station.	Inches.	Normal.	No of Days.
Mount Nuza...	4.98	8.44	13
Mtoko	3.52	3.13	6
New Year's Gift	2.63	2.95	7
Nuanetsi	0.91	2.54	0
Plumtree	3.98	2.82	8
Que Que	3.74	3.01	11
Rusapi...	2.36	4.58	9
Salisbury	3.41	3.65	11
Shabani...	2.12	1.88	7
Sinoia	7.68	3.50	15
Sipolilo...	0.64	3.17	9
Stapleford	5.55	6.80	12
Umtali...	3.44	3.84	12
Victoria Falls	4,56	2.39	12
Wankie...	2.45	2.02	10
Abercorn	3.69	—	12
Balovale	3.78	—	11
Broken Hill	1.91	—	8
Choma	1.79	—	8
Fort Jameson	4.93	—	7
Fort Roseberry	5.11	—	9
Isoka	3.09	—	5
Kalomo	4.82	—	10
Kanchindu...	0.94	—	7
Kapiri Mposhi	4.51	—	7
Kasama	5.94	—	13
Livingstone	4.78	—	12
Lundazi	0.88	—	3
Lusaka...	4.17	—	6
Mazabuka	1.57	—	3
Mongu	4.80	—	14
Mpika	2.56	—	6
Mporokoso	6.05	—	19
Mufulira	3.78	—	12
Ndola	3.88	—	9
Petauke	1.47	—	5
Senanga	3.60	—	13
Sesheke	3.17	—	6
Solwezi	7.73	—	14

NOVEMBER, 1938

Station	Altitude (Feet)	Temperature in Stevenson Screen at 4 feet °F: 8-30 a.m. Dry Bulb	8-30 a.m. Wet Bulb.	8-30 a.m. Dew Point	8-30 a.m. Vapour Press Deficit	Maximum	Minimum	Max + Min. ÷ 2	Absolute Maximum	Date	Absolute Minimum	Date	Number of Days Max > 85°	Max < 70°	Min. > 65°	Min. < 40°	Mean of 24 hours	Pressure Millibars: 8-30 a.m. Station Level	8-30 a.m. 1200 gdm	Mean of 24 hours	Cloud Tenths	Sunshine Hours
Beitbridge...	1,500	75.9	65.1	59	13.5	88.7	64.4	76.5	103	23	52	19	19	.	15		76.0	964.7	882.7	962.6	4.8	.
Bindura...	3,700	72.8	62.6	57	12.0	85.1	63.5	74.3	95	10	53	21	16	1	7	...	73.2	.	...	.	4.8	...
Bulawayo	4,393	68.2	59.1	52	9.9	80.3	58.9	69.6	90	22	49	17	8	2	..	..	68.7	869.9	881.4	868.2	6.2	6.9
Chipinga	3,685	69.8	61.7	57	9.1	78.9	59.3	69.1	90	23	50	17	5	2	2	...	68.2	893.1	882.5		5.0	...
Enkeldoorn	4,788	68.2	58.9	52	9.9	78.7	58.3	68.5	90	10	49	17	5	4	...	...	66.3	857.8	881.7	...	..	...
Fort Victoria... ...	3,571	70.4	60.8	55	11.0	82.8	61.1	71.9	95	22	48	19	15	3	5	...	70.7	895.6	881.4	...	5.2	...
Gwaai Siding... ...	3,278	73.6	62.8	56	13.0	89.1	61.1	75.1	97	5	44	17	24		7	..	.	904.3	881.0		5.0	...
Gwanda...	3,233	72.2	60.7	52	13.2	85.0	61.9	73.4	97	22	50	19	17	2	8	.	72.8	906.6	881.8		4.3	..
Gwelo	4,629	68.5	59.4	53	10.1	79.6	58.5	69.0	91	5	45	19	6	3	2	...	67.4	862.6	881.5		5.6	...
Hartley.	3,879	71.2	61.4	55	11.5	82.9	60.5	71.7	92	10	51	17	9	1	1	.	70.5	885.6	881.0	...	6.0	.
Inyanga...	5,503	68.1	58.0	50	10.9	75.7	54.8	65.3	87	11	44	21	1	5	..		63.9	..	.	..	5.0	..
Marandellas	5,453	67.0	58.1	51	9.6	76.6	57.1	66.8	89	10	51	19	2	5	..	..	65.8	..	...		4.6	...
Miami	4,090	70.3	60.8	54	10.9	83.9	61.7	72.8	94	11	54	17	15	2	4	...	71.0	878.6	880.6	876.8	3.9	..
Mt. Darwin	3,179	74.1	63.4	57	12.8	86.5	65.2	75.9	98	11	52	21	19	1	18		75.1	..	...	...	4.7	...
Mount Nuza	6,668	57.3	53.7	51	3.4	64.0	50.9	57.5	75	11	39	18	.	19	.	1	56.4	801.9	881.9	..	6.8	...
Mtoko	4,141	70.7	60.8	54	11.3	79.3	61.0	70.2	91	11	53	20	3	3	2	.	69.5	877.9	881.5	876.2	4.5	..
New Year's Gift...	2,690	72.7	63.1	57	11.2	84.7	61.2	72.9	96	10	54	17	14	1	5	.	.	...	...	...	...	7.1
Nuanetsi	1,581	76.7	65.5	59	14.1	89.7	62.5	76.1	100	10	50	19	20	...	8	...		962.3	882.6	..	5.1	...

NOVEMBER, 1938 (continued)

Station	Altitude (Feet)	Temperature in Stevenson Screen at 4 feet °F: 8-30 a.m. Dry Bulb	8-30 a.m. Wet Bulb	8-30 a.m. Dew Point	8-30 a.m. Vapour Press Deficit	Maximum	Minimum	Max + Min ÷ 2	Absolute Maximum	Date	Absolute Minimum	Date	Number of Days: Max > 85°	Max < 70°	Min > 65°	Min < 40°	Mean of 24 hours	Pressure Millibars: 8-30 a.m. Station Level	8-30 a.m. 1200 gdm	Mean of 24 hours	Cloud Tenths	Sunshine Hours
Plumtree	4,549	69.6	59.9	53	10.8	80.2	60.3	70.2	91	22	47	16	6	1	4	...	68.8	.	.		4.0	
Que Que	3,999	69.4	60.6	54	9.9	82.4	61.1	71.8	92	5	49	19	11	1	2	...	70.2	882.1	881.3	880.4	5.1	.
Rusape	4,648	68.4	59.4	53	10.0	79.3	57.6	68.4	91	10	47	21	8	4			66.9			...	3.8	
Salisbury	4,831	69.2	59.5	53	10.8	80.3	58.1	69.2	91	11	51	20	8	1			68.4	856.5	881.2	854.9	5.9	6.8
Shabani	3,131	72.4	61.8	55	12.2	84.4	62.7	73.6	96	22	50	19	19	3	10		74.5	.	...		5.0	..
Sinoia	3,795	73.0	63.2	57	12.0	84.3	61.3	72.8	95	11	52	17	12	1	3		72.0		..	.	5.1	.
Sipolilo	3,876	73.9	62.9	57	13.1	83.1	63.4	73.2	94	11	54	19	11	1	10	..	..	...		.	4.6	..
Stapleford	5,304	62.7	58.1	55	4.8	70.8	52.4	61.6	80	10	36	21		14		1	60.8		..		5.9	.
Umtali	3,672	69.6	62.3	58	8.3	80.0	60.6	70.3	93	11	50	21	8	4	4	.	68.9	893.3	882.3	891.7	5.1	..
Victoria Falls	3,009	74.8	65.0	59	12.5	89.7	64.8	77.2	99	5	51	17	24	.	16	...	75.7			.	4.3	..
Wankie	2,569	78.5	66.6	60	16.1	92.9	67.8	80.4	103	22	57	17	27		24	...	81.2	926.8	880.6	.	4.1	...
Abercorn	5,407	68.7	60.2	55	9.5	79.6	59.8	69.7	86	9	58	4	2			...		837.1	880.2	...	3.9	.
Broken Hill	3,920	72.6	62.4	56	12.0	85.3	64.5	74.9	95	11	55	19	17	2	12			883.9	880.1	...	5.0	...
Chipili	3,900	70.6	64.4	61	7.5	86.4	63.8	75.1	92	7	59	19	20		5				..	...		
Fort Jameson	3,620	74.6	63.6	57	13.3	86.4	66.4	76.4	96	11	56	20	20	1	17			887.5	881.1		2.6	..
Kasama	4,700	71.2	62.4	57	10.6	84.5	62.6	73.6	92	11	60	6	14		4			864.2	880.9	.	...	
Kasempa	4,500	67.0	63.3	61	4.2	80.2	59.4	69.8	89	11	53	4	3	1	...	.	..	.				..
Livingstone	3,140	71.9	64.0	59	9.6	88.4	63.8	76.1	96	22	49	17	25		12		74.2	911.2	880.5		5.6	..
Lusaka	4,193	72.6	61.7	54	12.8	83.5	64.3	73.9	94	11	55	19	14	2	10			874.8	880.1	.	5.8	6.7
Mongu	3,475	71.4	65.6	62	7.0	88.2	63.9	76.1	95	22	52	17	21	.	11	..		897.2	880.1		5.4	
Mpika	4,625		.				...		..	..						.	..	.	...	.	.	...
Mwinilunga	4,450	...				..	.	.		..	.	...				.	...	..	.		.	...
Ndola	4,140	71.0	62.9	58	9.3	84.1	61.5	72.8	94	11	55	20	17	2	...		...	875.2	880.2	..	4.3	...

Rainfall in November, 1938, in Hundredths of an Inch. Telegraphic Reports.

Area	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	Total	Normal
1	...	..	.	...	11	66	2	...	...	3	12	...	...	5	38	...	...		...	.	..		13	...	1	12	4		18	61	246	276
2	29	..	..	...	..	113	12	..	...	1	32	...	..		4	..	..		..		..	..	17	27	2		2	...	7	10	256	266
3	5	...	...	...	.	52	14	...	..		93	1	...	3	20	...	.	1	..	1			..	1	7	.	52	3	...	1	254	449
4	14	..	...	..	1	65	11	...	..	.	43	27	1	107	29	..		.			.		50	11	7	6	4	.	56	21	453	341
5	...	3	...	1	...	1	...	1	.	39	12	1		31	20	.					.		47	...	30	17	12	49	27	55	366	245
6	3	...	.	...	13	13		...		.	36	8	14	17	25	...	29	6	.	...			41	1		1	54	24	3	67	355	355
7	7	...	.	.	.	.	3	...	.	.	68	36	2	16	8	..	1		...			..	4	21	...	5	40	8	5	18	245	429
8	...	..	.	...	2	1	6	..	...		39	21	3	39	11	.	.	4	1	.	...		6	27		5	2	2	10	35	214	353
9	...	...	...	..	...	14	1		...		41	5		22	13	.	110	6	6	...	...		24	10	3	4	2	9	8	44	322	311
10	...	...	...	...	...	..	...	...	.		47	27	3	.	6	123		3	...	..		.			...	4	...	.	.	.	213	329
Mean	6	1	..	..	4	36	4	...	.	7	33	13	2	22	19	6	18	2	1	.	.		25	9	7	7	15	13	15	40	305	311

Southern Rhodesia Veterinary Report.

OCTOBER, 1938.

DISEASES.

Anthrax was diagnosed on Kelvingrove farm, Victoria district. Mortality: Two head of cattle.

TUBERCULIN TEST.

Two bulls were tested upon importation with negative results.

MALLEIN TEST.

Fifty-two horses, 10 mules and 20 donkeys were tested during the month. No reactions.

IMPORTATIONS.

From United Kingdom.—Bulls 2, horses 1.

From Union of South Africa.—Horses 51, mules 10, donkeys 4, sheep 1,342, goats 1, pigs 5.

From Bechuanaland Protectorate.—Sheep 607.

EXPORTATIONS.

To Union of South Africa.—Oxen 593, cows 11.

To Northern Rhodesia.—Oxen 36, horses 1, donkeys 16, pigs 1.

To Portuguese East Africa.—Oxen 14.

EXPORTATIONS—MISCELLANEOUS.

To United Kingdom.—Chilled beef quarters, 5,762; frozen boned beef quarters, 1,804; kidneys, 2,785 lbs.;

tongues, 7,048 lbs.; livers, 6,453 lbs.; hearts, 1,774 lbs.; tails, 1,300 lbs.; skirts, 1,941 lbs.

To Northern Rhodesia.—Beef carcases, 335¾ lbs.; mutton carcases, 10; pig carcases, 9; veal carcases, 13.

To Belgian Congo.—Beef carcases, 61½; veal carcases, 36.

Meat Products.—From Liebig's Factory.

To Union of South Africa.—Corned beef, 152,726 lbs.; beef fat, 24,000 lbs.; tongues, 5,940 lbs.

To United Kingdom.—Meat extract, 21,444 lbs.; beef powder, 80,003 lbs.

To Bechuanaland Protectorate.—Corned beef, 180 lbs.

To Northern Rhodesia.—Meat meal, 2,000 lbs.

To Portuguese East Africa.—Beef fat, 500 lbs.

B. L. King,
Acting Chief Veterinary Surgeon.

SOUTHERN RHODESIA.

Locust Invasion, 1932-38.

Monthly Report No. 72. November, 1938.

Flying swarms of the Red Locust (*Nomadacris septemfasciata*, Serv.) were reported during the month from nineteen districts in the Colony as follows:—

Mashonaland.—Bikita, Charter, Chilimanzi, Darwin, Hartley, Makoni, Marandellas, Mtoko, Mazoe, Melsetter, Victoria and Umtali.

Matabeleland.—Belingwe, Bulalima-Mangwe, Bulawayo, Chibi, Insiza and Nyamandhlovu.

A number of swarms have flown south from Matabeleland into the Northern Transvaal and Bechuanaland. Some of the swarms are assuming the mating colouration (turning yellowish) and the ovaries are developing. Two unconfirmed reports were received at the end of the month that egg-laying had taken place, though it is considered that egg-laying will not become general for another two or three weeks.

Locust birds, storks and kites have been following many of the swarms.

Some damage to gum plantations, wheat, early maize, vegetable gardens and grazing has occurred.

As few reports have been received and many of the swarms are small, the coming hopper outbreak may be similar to last year's, *i.e.*, on a fairly small scale.

J. K. CHORLEY,
Acting Chief Entomologist.

Departmental Bulletins.

The following Bulletins are available for distribution at 3d. per copy. Application should be made to the Editor, Department of Agriculture, Salisbury, and remittances must accompany orders.

N.B.—The date the article appeared in the Journal is indicated in abbreviated form before the number, e g., 8/22, No 429, means that Bulletin 429 appeared in the Journal for August, 1922.

AGRICULTURE AND CROPS.

3/31. No. 815. New Strains of Oats for Southern Rhodesia, by H. C. Arnold, Manager, Agricultural Experiment Station, Salisbury.

4/31. No 816. Preliminary List of the more Common Grasses of Southern Rhodesia, by Sydney M. Stent, Botanist for Pasture Research

5/31. No. 822. Re-stacking of Maize rejected for Export on account of Excessive Moisture

9/31. No 826. Some Poisonous Plants of Southern Rhodesia, by Sydney M Stent, Senior Botanist.

10/31 No 831. Revised Notes on Cotton Growing in Southern Rhodesia, by G. S Cameron

11/31. No. 836. The Potato, by S. D Timson, M C, Dip Agric (Wye).

12/31. No. 837. Veld Grass Silage: A Feature in Rhodesian Pasture Management, by H G Mundy, Dip Agric (Wye), F L.S., Chief, Division of Plant Industry.

6/32. No. 855 Pigeon hole Method of Stacking Maize, by Division of Plant Industry.

8/32. No. 859. Twenty-one Years of Plant Introduction, by Major Mundy, Chief Division of Plant Industry.

2/33. No 878 A I V. Silage: Memorandum prepared and circulated by Imperial Bureau of Animal Nutrition.

11/34. No. 936. Witchweed, by S D Timson, M C. Dip.Agric. (Wye), Assistant Agriculturist

10/35 No 970 Rhodes Grass for the Southern Rhodesian Tobacco Grower, by African Explosives and Industries, Ltd.

11/35 No. 972. Notes on Witchweed, by S. D. Timson, M.C., Dip.Agric. (Wye), Assistant Agriculturist

6/36. No. 992. Annual Report of the Agriculturist for the year 1935, by D E. McLoughlin, Agriculturist.

7/36. No 994. Some Notes on Cotton Growing, by J E. Peat, Senior Plant Breeder, Cotton Station, Gatooma.

4/37. No. 1022. Smut Diseases of Wheat in Southern Rhodesia, by G. M. Wickens, B.Sc Agric., Ph D, D.I C, Plant Pathologist, Tobacco Research Station, Trelawney.

10/37. No. 1046. Green Manuring: Two Important Factors Affecting Success, by S D Timson, M.C., Assistant Agriculturist, and H C. Arnold, Manager, The Agricultural Experiment Station

10/38. No. 1084 Improved Pastures, by S D Timson, M C., Assistant Agriculturist

REPORTS ON CROP EXPERIMENTS.

7/27. No. 649 Annual Report of Experiments, 1925-26, Agricultural Experiment Station, Salisbury, by H. C. Arnold, Manager

4/28. No. 683. Annual Report of Experiments, 1926-27, Agricultural Experiment Station, Salisbury, by H C. Arnold, Station Manager.

7/29. No. 745. Salisbury Agricultural Experiment Station Annual Report, 1927-28, by H. C. Arnold

7/30. No. 789. Agricultural Experiment Station, Salisbury, Annual Report of Experiments, 1928-29, by H C. Arnold

9/31. No. 830. Salisbury Agricultural Experiment Station, Annual Report, 1929-30, by H. C. Arnold, Manager

10/32. No. 864. Annual Report, 1930-31: Agricultural Experiment Station, by H. C. Arnold, Station Manager.

TOBACCO.

12/36. No. 1009. Tobacco Research on the Trelawney Station 1935-36 Season

4/37. No. 1025. Report of the Tobacco Research Board, by Chas. K. Brain, M.A., D.Sc., Director of Agriculture and Chairman of the Tobacco Research Board.

5/37. No. 1026. Notes on Tobacco Root-Knot Nematode, by J. C. Collins, B.Sc., Biologist, Trelawney Tobacco Research Station.

8/37. No. 1039. Some Tobacco Pests that can be serious, by M. C. Mossop, M.Sc., Entomologist, Department of Agriculture.

1/38. No. 1054. Alkalinity of Tobacco Seed-bed Soils, by A. P. Taylor, M.A., B.Sc., Agricultural Chemist.

3/38. No. 1063. A New and Serious Disease of Tobacco in Southern Rhodesia, by G. M. Wickens, Ph.D., D.I.C., Plant Pathologist, Tobacco Research Station, Trelawney.

5/38. No. 1070. A Witchweed on Tobacco Roots (*Striga orobanchoides*, Benth.), by Chas. K. Brain, M.A., D.Sc., Director of Agriculture.

6/38. No. 1072. Report of the Tobacco Research Board for the year ending 31st December, 1937, by Chas. K. Brain, M.A., D.Sc., Director of Agriculture, and Chairman of the Tobacco Research Board

LIVE STOCK.

1/27. No 624. The Construction of Dipping Tanks for Cattle (Revised).

1/31. No. 801. Sheep Farming in the Melsetter District, by J. C. Kruger, Part-time Sheep Adviser in the Melsetter District.

10/32. No. 863. Piggeries, by B. G. Gundry, A.I.Mech.E.

12/32. No. 871. Some General Observations on the Feeding of Dairy Cows on a Mixed Stock Farm, by Dr. A. E. Romyn, Senior Animal Husbandry Officer.

4/33. No. 887. The Type of Chiller Steer required for Export, by A. E. Romyn, Senior Animal Husbandry Officer.

9/33. No. 903. The Handling, Preparation and Chilling of Cattle for Export, by C. A. Murray, Lecturer in Animal Husbandry.

12/33. No 907. The Blackhead Persian: Its Breeding and Management in Matabeleland, by C. A. Murray, M.Sc., Lecturer in in Animal Husbandry, Matopo Estate.

1/34. No 909. Stall Fed Chillers for the Overseas Christmas Market, by C. A. Murray, M.Sc., Animal Husbandry Officer, Matopo School of Agriculture and Experiment Station, Rhodes Matopo Estate.

2/34. No 912. Economical Winter Rations for Wintering Dairy Heifers, by C. A. Murray, M.Sc. (Agric), Lecturer in Animal Husbandry, Matopo School of Agriculture.

4/34. No. 916. Cowpea Hay in the Ration for Bacon Pigs, by C. A. Murray, M.Sc. (Agric.), Lecturer in Animal Husbandry, Matopo School of Agriculture and Experiment Station.

6/34. No. 924. Raising Dairy Calves on a Limited Amount of Whole Milk, by C. A. Murray, M.Sc., Agr., Animal Husbandry Officer, Matopo School of Agriculture and Experiment Station, Rhodes Matopo Estate.

1/35. No. 943. Cattle Improvement and a Cattle Breeding Policy in Southern Rhodesia: A Review of the General Position Chiefly as regards Ranching Cattle, by Dr. A. E. Romyn, Chief Animal Husbandry Officer.

1/35. No. 945. A Home-made Cow Stanchion, by Major R. R. Sharp, Whinburn, Redbank.

3/35. No. 946. Economical Rations for Wintering Dairy Cattle, by C. A. Murray, M.Sc. (Agric.), Senior Animal Husbandry Officer in Charge, Matopo School of Agriculture and Experiment Station.

5/35. No 952. Annual Report of the Chief Animal Husbandry Officer for the year ending 31st December, 1934, by A. E Romyn, Chief Animal Husbandry Officer.

7/35. No. 959. The Selection of a Dairy Bull, by A. E. Romyn, Ph.D., Chief Animal Husbandry Officer.

4/36. No. 984 Report on the Curing of Rhodesian Hides, by Advisory Committee on Hides and Skins of the Imperial Institute.

4/36. No 985. Export of Frozen Porkers. Third Consignment to Smithfield. Division of Animal Husbandry.

5/36. No. 987. The Curing of Hides and Skins on the Farm, by The Division of Animal Husbandry.

5/36. No. 988. Preparing Cattle for Show, by The Animal Husbandry Division.

6/36. No. 989. The Supplementary Feeding of Mineral and Protein Supplements to Growing Cattle in Southern Rhodesia and its Relation to the Production of Beef Steers, by C. A. Murray, M.Sc. (Agric.), Senior Animal Husbandry Officer in Charge, Rhodes Matopo Estate; A. E Romyn, Ph.D., Chief Animal Husbandry Officer, Department of Agriculture, Southern Rhodesia; D. G. Haylett, Ph.D., Director, Rhodes Matopo Estate; F. Ericksen, Dip. Agric., Experimentalist

10/36. No. 1001. The Raising of Bacon Pigs, by A. E. Romyn, Chief Animal Husbandry Officer, and C. A. Murray, Senior Animal Husbandry Officer in Charge, Rhodes Matopo Estate, with a Veterinary Section by D. A. Lawrence, Director of Veterinary Research.

9/36. No. 1000. Sheep Management on the Mixed Farm, by R H. Fitt, Animal Husbandry Officer.

4/37. No. 1023. Cowpea Molasses Silage for Fattening Steers, by C A. Murray, M.Sc. (Agric.), Senior Animal Husbandry Officer in Charge, Matopo School of Agriculture and Experiment Station; A. E. Romyn, Ph.D., Chief Animal Husbandry Officer, Department of Agriculture, Salisbury; R. H. Fitt, Dipl. Agric., Animal Husbandry Officer, Department of Agriculture, Salisbury.

4/37. N. 1024. Comparative Feeding Value of Maize Meal and Nyouti (*Pennisetum Typhoides*) Meal for Fattening Steers, by C. A. Murray, Senior Animal Husbandry Officer in Charge, Rhodes Matopo Estate; A. E. Romyn, Chief Animal Husbandry Officer.

5/37. No. 1027. The Feeding of Phosphorus Supplements to Growing Cattle, by C. A. Murray and A. E. Romyn.

5/37. No 1029. The Dehorning of Cattle intended for Slaughter and Export, by B. A. Myhill, Assistant Chief Veterinary Surgeon.

5/37. No. 1030 The Feeding of Different Winter Supplements to young growing steers and the effect of these supplements on the subsequent development and costs of production of the steers, by C. A. Murray and A. E. Romyn.

6/37. No. 1032. The Effects of Feed on the Firmness and Grading of Bacon Carcases, an experiment carried out by the Division of Animal Husbandry in co-operation with Mr. A. L. Millar, Estes Park, Salisbury, and Mr. Frank Neill, of Neill's Bacon Factory, Salisbury.

6/37. No. 1034. Nyouti or Munga (*Pennisetum typhoides*) as a Feed for Bacon Pigs, by C. A. Murray and A. E. Romyn.

7/37. No. 1036. Preliminary Report on the Feeding of Winter Supplements to young growing steers and the effect of supplementary feeding on the subsequent development of these animals, by C. A. Murray and A. E. Romyn.

12/37. No. 1049. The Export of Frozen Porkers: Report on Five Consignments of Porkers Exported to Smithfield, by Division of Animal Husbandry.

1/38. No. 1053 The Feeding of Sunnhemp Hay as compared with Cowpea Hay in the Fattening Ration for Bullocks, by A E. Romyn and R H. Fitt

2/38. No. 1058 Pig Industry Act, 1937 Division of Animal Husbandry.

3./38. No. 1062. Protein Supplements for Fattening Bullocks, by A. E. Romyn and R H Fitt.

9/38. No. 1083. Internal Parasites in Sheep, by Percy D Huston, M R.C.V S., District Veterinary Officer.

11/38 No 1091. Cost of Fattening Bullocks of various ages in Matabeleland, by A E. Romyn and C A. Murray

DAIRYING.

12/30. No. 799. The Objects of Ripening Cream for Butter-making, and a few Hints on Cream Production, by F. Lammas, Dairy Officer.

9/32. No 862. Cream Cheese, by F. A. Lammas, Dairy Officer.

3/33. No 880. Dairy Tests and Calculations, by F. A. Lammas, Dairy Officer.

5/34. No. 922. Dairy Building in Southern Rhodesia: A Small Farm Dairy, by G. B. Gundry, A.I Mech.E.

7/34. No. 926. Dairy Buildings in Southern Rhodesia. Cow Byre—Type II., by B. G. Gundry, A.I.Mech.E.

12/34. No 937. Gouda or Sweet Milk Cheese, by F. Lammas, District Dairy Officer.

2/36. No. 977. Notes on the Feeding of Dairy Cows during the Summer Months, by A. E. Romyn, Chief Animal Husbandry Officer.

6/36. No. 990. Southern Rhodesia Milk Recording Scheme.

12/37. No. 1051. The Production and Handling of Milk and Cream, by the Dairy Branch.

12/38. No. 1094. Farm Butter Making, by The Dairy Branch

VETERINARY.

IRRIGATION, WATER SUPPLIES AND SOIL EROSION.

3/31. No 811. Irrigation Canal Structures, by R. H. Roberts, B.Sc. (Eng.), Assistant Irrigation Engineer.

8/32. No 860. Soil Drainage and Utilisation of Vleis, by R. H. Roberts, B.Sc. (Eng.), Assistant Irrigation Engineer.

2/33 No 879 Conditions Governing the Hire of Government Boring Machines.

8/33. No. 900. Three Types of Water Tank, by R H. Roberts, B.Sc. (Eng), A M I C E., Assistant Irrigation Engineer.

6/35. No 956. Annual Report of the Division of Irrigation for the year ended 31st December, 1934, by P. H. Haviland, B.Sc. (Eng), Acting Chief Irrigation Engineer

9/35. No. 964. The Use of Ditchers for Constructing Contour Ridges, by C. Tapson, Devondale. Concession.

9/35. No. 967 How to use an Engineer's or Farm Level, by P. H Haviland, B Sc (Eng), A M.I C.E , Irrigation Engineer (Matabeleland)

12/35 No 973 Domestic Water Supplies and Sanitation on the Farm, by P H Haviland, B Sc (Eng), A.M I C.E.. Irrigation Engineer (Matabeleland)

3/36 No 980 Results from Glenara Soil Conservation Experiment Station, 1934 35 Season. by C. L. Robertson, B.Sc. A M I C E , Chief Engineer, Irrigation Division, and A. D. Husband, F I C , Chief Chemist

8/36 No 999 Lining an Irrigation Furrow, by R H. Roberts, B S., A M Inst C E Assistant Irrigation Engineer

3/37. No 1019 Soil Conservation, by D Aylen, Esq , Outside Technical Assistant, and R. Hamilton Roberts, B Sc., A M.Iinst C E , Irrigation Engineer

1/38. No. 1052 Small Earthen Storage Dams. Part I. By the Irrigation Division

2/38 No. 1055 Small Earthen Storage Dams Part II. By the Irrigation Division.

3/38 No. 1061 Soil Drainage and Utilisation of Vleis, by R. H. Roberts, B Sc. (Eng). Assistant Irrigation Engineer.

7/38 No 1077. A Small Brick Irrigation Furrow, by H. W. H. Wallis, Assistant Irrigation Engineer.

FORESTRY.

11/29. No 763. The Utilisation of Wood, by T. L. Wilkinson, M.Sc., B.Sc F.

1/30. No 769. The Utilisation of Wood, by T L. Wilkinson, M.Sc., B.Sc F.

4/30. No. 778. The Utilisation of Wood in Southern Rhodesia—Conversion and Disposal of Timber, by T. L. Wilkinson, M.Sc., B.Sc F., District Forest Officer.

8/30. No. 791. The Utilisation of Wood in Southern Rhodesia: Fencing, by T. L. Wilkinson, M.Sc , B.Sc F., District Forest Officer.

2/31. No. 809. Establishing Pines: Preliminary Observations on the Effects of Soil Inoculation Issued by the Division of Forestry.

4/31. No. 817 The Raising of Forest Seedlings and Transplants on the Farm, by E. J Kelly Edwards, M.A., Dip.For. (Oxon.), Acting Chief Forest Officer.

7/32. No. 857. Charcoal Burning on the Farm, by R. J. Allen, Forester, Rhodes Matopo School of Agriculture and Experiment Station.

11/32. No 869. Wind-breaks and Shelter Belts, by A. A. Pardy, B.Sc., Forestry.

1/33. No. 874. Tree Planting, by the Division of Forestry.

4/33. No. 888. The Vegetable Ivory Palm (Hyphoene ventricosa), by G. M. McGregor, B.Sc., District Forest Officer, Matabeleland.

8/34. No. 927. Some Facts about Tung Oil, by R. H. Finlay, B.A., Dip. For. (Oxon.), District Forest Officer.

8/34. No. 928. Some Trees, Shrubs, Shrubby-Herbaceous Plants, Climbers and Water Plants suitable for the Colony, by J. W. Barnes, Manager, Government Forest Nursery, Salisbury.

12/35. No. 974. Summary of the Annual Report of the Division of Forestry for the year 1934, by E. J. Kelly-Edwards, M.A., Dip. For. (Oxon.), Chief Forest Officer.
Price List of Forest-tree Transplants, Ornamental Trees Shrubs, Hedge Plants, Creepers and Seeds obtainable at the Government Forest Nursery, Salisbury.

3/37. No. 1020. The Raising of Forest Seedlings and Transplants on the Farm, by E. J. Kelly Edwards, M.A., Dip. For. (Oxon.), Conservator of Forests.

10/37. No. 1045. Seventeenth Annual Report of the Division of Forestry for the Year 1936, by E. J. Kelly Edwards, M.A., Dip. For. (Oxon.), Conservator of Forests.

6/38. No. 1073. Pruning of Plantations, by R. H. Finlay, B.A., Oxon , Division of Forestry.

7/38. No. 1076. Eighteenth Annual Report of the Division of Forestry for the year 1937, by E. J. Kelly Edwards, M.A., Dip. For. (Oxon.), Conservator of Forests.

10/38. No. 1085. The Pot Planting of Eucalypts, by Major G. R. Wake, Vigila, Umvukwes.

11/38. No. 1087. The Raising and Planting of Trees on the Farm, by E J. Kelly Edwards, M.A., Dip. For. (Oxon), Conservator of Forests

HORTICULTURE

4/27. No. 637. Harvesting, Packing and Marketing of Deciduous and Tropical Fruits, by G. W. Marshall, Horticulturist.

8/27. No. 650. Coffee Culture in Southern Rhodesia, by G. W. Marshall, Horticulturist.

2/29. No. 725. Investigations into "Collar-Rot" Disease of Citrus, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A. (Trinidad)

3/31. No. 814. Avocado Growing in South Africa, by Redvers J. Blatt, B.Sc., Ph.D.

11/31. No. 834. Celery Culture, by G. W. Marshall, Horticulturist.

1/32. No. 843. Vegetable Growing in Southern Rhodesia: Onion Culture, by G. W. Marshall. Horticulturist.

2/33. No. 876. Notes on African Aloes (Parts 1-6), by H. Basil Christian, "Ewanrigg," Arcturus.

10/33. No. 905. Notes on African Aloes (Parts 7-10), by H. Basil Christian, "Ewanrigg," Arcturus.

5/34. No. 920. Citrus Fruit Growing in Rhodesia, by G. W. Marshall, Horticulturist.

5/37. No. 1028. Tomato Culture in Southern Rhodesia, by G. W. Marshall, Horticulturist.

9/37. No. 1043. The Rhodesian Home Orchard, by G. W. Marshall, Horticulturist.

ENTOMOLOGY AND PLANT PATHOLOGY.

2/13. No. 139. Termites, or "White Ants," by Rupert W. Jack, F.E.S

6/15. No. 214. Some Household Insects, by R. Lowe Thompson, B.A.

2/21. No 385. The Common Fruit Beetle, by R. W. Jack, F.E.S.

12/24 No. 522 Notes on the Black Citrus Aphis, by C. B. Symes.

8/25. No. 548. Insect Pests of Cotton, by C. B. Symes.

9/27. No. 653. The Care of Tobacco Seed Beds, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A. (Trinidad).

1/28. No. 665. Tobacco Pests of Rhodesia, by Rupert W. Jack, F.E.S., Chief Entomologist.

2/28. No. 671. Wildfire and Angular Spot of Tobacco, by J. C. F. Hopkins, B.Sc., A.I.C.T.A.

6/28. No. 696. Ticks Infesting Domestic Animals in Southern Rhodesia, by Rupert W. Jack, F.E.S., Chief Entomologist.

11/28. No. 714. Trap Cropping against Maize Pests, by Rupert W. Jack, F.E.S., Chief Entomologist.

12/28. No. 718. Preliminary Experiments on the Control of White Mould of Tobacco, by J. C. F. Hopkins, B.S. (Lond.), A.I.C.T.A., Chief Botanist and Mycologist.

3/29. No. 732. Two Common Diseases of Potato Tubers in Rhodesia, by J C. F. Hopkins, B.Sc (Lond.), A.I.C.T.A.

6/29 No. 742. What is Diplodia in Maize? An Answer to a Popular Question To day, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A., Chief Botanist and Mycologist.

8/29. No. 748 Frog Eye Disease of Tobacco, by J. C. F. Hopkins, B.Sc (Lond.), A.I.C.T.A., Chief Botanist and Mycologist.

9/29. No. 753. Leaf Spotting of Tobacco caused by Mosaic, by J. C. F. Hopkins, B.Sc (Lond.), A.I.C.T.A., Chief Botanist and Mycologist.

9/29. No. 754. "Pinking" of Maize: Report of a Preliminary Investigation, by T. K. Sansom, B.Sc., Plant Breeder.

6/30. No. 784. Field Control of Frenching in Tobacco, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A., Plant Pathologist.

6/30. No. 788. A List of Plant Diseases Occurring in Southern Rhodesia, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T A., Plant Pathologist.

A List of Plant Diseases Occurring in Southern Rhodesia, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A., Plant Pathologist. Supplement No. 1.

7/30. No. 790. Notes on the Control of Some of the More Important Insect Pests of Citrus in Southern Rhodesia, by W. J. Hall, Ph.D., B.Sc., Entomologist to the British South Africa Company in Southern Rhodesia.

10/30. No. 796. The Army Worm (Laphygma exempta, Wlk.), by Rupert W. Jack, Chief Entomologist.

11/30. No. 798. The Preparation of Bordeaux Mixture and Seasonal Notes on Tobacco Diseases, by J. C. F. Hopkins, B.Sc. (Lond.), A.I C.T.A.

1/31. No. 804. Locusts in Southern Rhodesia, by Rupert W. Jack, Chief Entomologist.

8/31. No. 825 Some Common Diseases of Potatoes in Southern Rhodesia, by J. C. F. Hopkins, B.Sc. (Lond.), Plant Pathologist.

3/32. No. 848. Mycological Notes: Seasonal Notes on Tobacco Diseases: 3, Frog Eye; 4, White Mould; by J. C. F. Hopkins, B.Sc. (Lond.).

4/32. No. 850. Pests of Stored Tobacco in Southern Rhodesia, by M. C. Mossop, M.Sc., Entomologist.

6/32. No. 856. A List of Plant Diseases occurring in Southern Rhodesia, Supplement 2, by J. C. F. Hopkins, B.Sc. (Lond.), Government Plant Pathologist.

9/32. No. 861. Further Notes on Leaf Curl of Tobacco in Southern Rhodesia, by J. C. F. Hopkins, B.Sc. (Lond.), Plant Pathologist.

11/32. No. 868. Cultural Methods and Tobacco Whitefly in Southern Rhodesia, by M. C. Mossop, M.Sc., Entomologist.

5/33. No. 892. The Tsetse Fly Problem in Southern Rhodesia, by R. W. Jack, Chief Entomologist.

5/33. No. 893. Experiments with Tsetse Fly Traps against Glossina Morsitans in Southern Rhodesia, by R. W. Jack, Chief Entomologist.

6/33. No. 894. Mycological Notes. Seasonal Notes on Tobacco Diseases. 6. An Unusual Type of Frog Eye Spotting, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A., Government Plant Pathologist.

6/33. No. 896. A List of Plant Diseases occuring in Southern Rhodesia. Supplement 3. (New Records for period June, 1932, to May, 1933.) Compiled by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A., Government Plant Pathologist.

7/33. No. 897. The Report of the Chief Entomologist for the year ending 31st December, 1932, by Rupert W. Jack, F.E.S., Chief Entomologist.

8/33. No. 899. The Black Maize Beetle (Heteronchus Licus Klug), by C. B. Symes

10/33. No. 904. Notes on the Biology and Control of the Red Locust in Southern Rhodesia, 1932-1933. Part I.: Control of Locusts, by R. W. Jack, Chief Entomologist. Part II.: Biological Notes on the Red Locust (Nomadacris septemfasciata, Serv.), by M. C. Mossop, A.F.C., M.Sc., Entomologist.

10/33. No. 906. The Locust Invasion of Southern Rhodesia, 1932-33, by R. W. Jack, Chief Entomologist.

2/34. No. 911. Screw Worm. A Pest of Ranch Cattle in Southern Rhodesia, by A. Cuthbertson, Entomologist. Foreword by R. W. Jack, Chief Entomologist.

3/34. No. 913. Locusts: Instructions for dealing with Flying Swarms, by The Division of Entomology

4/34. No. 917. The Life History of the Screw-worm Fly, by Alexander Cuthbertson, Entomologist.

10/34. No 934. Mycological Notes. Seasonal Notes on Tobacco Diseases. 7, Spraying in Seed-beds and Lands, by J. C. F. Hopkins, D.Sc. (Lond.), A.I.C.T.A., Senior Plant Pathologist.

12/34. No. 938. The Destruction and Control of Locust Hoppers, by R. W. Jack, Chief Entomologist.

1/35. No. 942. Mycological Notes. Seasonal Notes on Tobacco Diseases. 8, The Mosaic Mystery. 9, Danger Points in Field Spraying, by J. C. F. Hopkins, D.Sc. (Lond.), A.I.C.T.A., Senior Plant Pathologist.

4/35. No. 950. The Control of Tsetse Fly in Southern Rhodesia, by Rupert W. Jack, Chief Entomologist.

4/35. No. 951. Suspected "Streak" Disease of Maize. Notice to Growers, by J. C. F. Hopkins, D.Sc. (Lond.), A.I.C.T.A., Senior Plant Pathologist.

6/35. No. 957. Annual Report of the Branch of Plant Pathology for the year ending 31st December, 1934, by J. C. F. Hopkins, D.Sc. (Lond.), A.I.C.T.A., Senior Plant Pathologist.

8/35. No. 962. The Report of the Chief Entomologist for Year ending 31st December, 1934, by R. W. Jack, Chief Entomologist.

10/35. No. 969. The Objects and Value of Seed Treatment of Maize against Diplodia, by G. M. Wickens, Ph.D. (Lond.), D.I C , Assistant Plant Pathologist.

5/36. No. 986 Annual Report of the Division of Entomology for year ending 31st December, 1135, by Rupert W Jack, Chief Entomologist.

7/36. No. 993. Annual Report of the Senior Plant Pathologist for year ending 31st December, 1935. Part I.: Plant Pathology. Part II.: Tobacco Research, by J. C. S. Hopkins, D.Sc. (Lond.), A.I.C.T.A., Senior Plant Pathologist and Officer in Charge of Tobacco Research Station, Trelawney.

12/36 No. 1011 Tick Infesting Domestic Animals in Southern Rhodesia, by Rupert W Jack, Chief Entomologist. Revised, November, 1936

7/37. No 1037 Division of Entomology: Annual Report for year 1936, by R W. Jack. Chief Entomologist

8/37. No 1040 A Programme for the Control of Diseases of Apple Trees in Southern Rhodesia, by J C F Hopkins, D.Sc (Lond), A.I C T A., Senior Plant Pathologist.

10/37. No 1047. Mycological Notes: Seasonal Notes on Tobacco Diseases. X.: Precautionary Methods in Seed-beds, by J C F Hopkins, D.Sc (Lond), A.I.C.T A., Senior Plant Pathologist

12/37 No. 1050. An Unusual Winter Outbreak of Maize Weevil *Calandra oryzae*, L), by M. C. Mossop, M.Sc., Entomologist, Department of Agriculture

2/38 No. 1059. A Poison Bait for Young Locust Hoppers

6/38 No. 1071. Common Diseases of Apples and their Control in Southern Rhodesia, by J C. F. Hopkins, D Sc. (Lond.), A.I.C.T A., and Aline L. Bacon, B Sc , Division of Plant Pathology.

6/38. No. 1074. A Note on a Stem Rot of Sweet Peas, by J. C. F. Hopkins, D.Sc., A I.C T.A., Senior Plant Pathologist.

7/38 No 1078. Mycological Notes: Seasonal Notes on Tobacco Diseases. II. Two Destructive Curing Moulds, by J. C. F. Hopkins, D.Sc. (Lond.), A.I.C.T A., Senior Plant Pathologist.

8/38. No. 1079. Annual Report of the Branch of Plant Pathology for the year ending 31st December, 1937, by J. C. F. Hopkins, D.Sc. (Lond.), A.I.C T A., Senior Plant Pathologist.

8/38. No. 1080. Annual Report of the Division of Entomology for the year ended 31st December, 1937, by Rupert W. Jack, Chief Entomologist.

9/38. No. 1082. The Life History of Root Gallworm or Root Knot Eelworm, by M. C. Mossop, M.Sc., Entomologist.

10/38. No. 1086. The Spraying of Tobacco Seed-beds and Control of Rosette Disease, by J. C. F. Hopkins, D.Sc. (Lond.), A.I.C.T.A., Senior Plant Pathologist, and M. C. Mossop, M.Sc , Entomologist.

POULTRY.

1/29.	No.	721.	Poultry Keeping in Rhodesia: Pedigree Breeding, by H. G. Wheeldon, Assistant Poultry Expert.
4/29.	No.	738.	Hints to Breeders: Rearing Young Stock, by A. Little, Poultry Expert.
6/29.	No.	740.	Artificial Incubation, Breeding and Rearing of Chicks, by H. G. Wheeldon, Poultry Expert.
11/29.	No	761.	Housing and Feeding of Adult Stock, by H. G. Wheeldon, Poultry Expert.
10/30.	No.	795.	The Turkey, by G. H. Cooper, Assistant Poultry Officer
1/31.	No.	803.	Geese, by G. H. Cooper, Assistant Poultry Officer.
9/31.	No.	827.	The Ideal Brooder, by F. Roberts, Assistant Poultry Officer.
10/32.	No.	865.	Poultry Industry: Care of Young Stock in Hot Weather, by H. G. Wheeldon, Chief Poultry Officer.
11/32.	No.	870.	Trap Nests, by B. G. Gundry, A.I.MechE. (combined with No. 875).
12/32.	No.	872.	The Rearing and Fattening of Table Poultry, by H. G. Wheeldon, Chief Poultry Officer.
3/33.	No.	884.	The Vitamins in Poultry Feeding, by G. H. Cooper, Poultry Officer, Matopo School of Agriculture and Experiment Station.
5/34.	No	918.	The Moulting of Poultry: The Normal and Pullet Moult, by H. G. Wheeldon, Poultry Officer.
10/34.	No	933.	Ducks on the Farm (Revised), by H. G. Wheeldon, Poultry Officer.
12/34.	No	939.	The Use of Galvanised Iron in the Making of Some Appliances for Poultry Keeping, by G. H. Cooper, Assistant Poultry Officer, Matopo School of Agriculture and Experiment Station.
12/34.	No.	940.	A Cheap Portable Colony House for Poultry, by G. H. Cooper, Assistant Poultry Officer, Matopo School of Agriculture and Experiment Station.
3/34.	No.	947.	Modern Culling of Laying Hens, by G. H. Cooper, Assistant Poultry Officer, Matopo School of Agriculture and Experiment Station.
9/35.	No.	966.	Egg Marketing Bill: Draft of a Bill having for its purpose the more orderly Marketing of Eggs.
11/35.	No.	971.	Feeds for Poultry and How to Use Them, by G. H. Cooper, Assistant Poultry Officer.

The following pamphlets can be obtained from the Poultry Officer upon application:—

Selecting Birds for Laying Tests, by A. Little, Poultry Expert.

Tuberculosis, by A. Little, Poultry Expert.

Prevention of Disease among Poultry, by A. Little, Poultry Expert.

Preparing Birds for Show, by A. Little, Poultry Expert.

The Fowl Tick (Argas persicus), by A. Little, Poultry Expert.

Culling: A Seasonal Operation, by A. Little, Poultry Expert.

Choosing a Male Bird, by A. Little, Poultry Expert.

The Breeding Stock, by A. Little, Poultry Expert.

Diseases of the Digestive System, by A. Little, Poultry Expert.

Mating for Improvement and Increased Egg Production, by A. Little, Poultry Expert.

Partial Moult: Broodiness. Selection of Layers of Large Eggs, by A. Little, Poultry Expert.

Exhibiting Eggs at Shows, by A. Little, Poultry Expert.

Condition of Birds on Show, by A. Little, Poultry Expert.

Green Food: The Result of not Supplying Sufficient to Poultry, by A. Little, Poultry Expert.

Good and Bad Hatching Eggs, by A. Little, Poultry Expert.

Grading Fowls, by A. Little, Poultry Expert.

Housing: Three Important Essentials, by A. Little, Poultry Expert.

Advice to Prospective Poultry Farmers, by A. Little, Poultry Expert

Seasonal Hints—August, by A. Little, Poultry Expert.

Successful Chick Rearing, by H. G. Wheeldon, Assistant Poultry Expert.

Hints to Breeders, October, by A. Little, Poultry Expert.

Abnormalities in Eggs, by A. Little, Poultry Expert.

Hints to Breeders. Prepare for the Breeding Season, by A. Little

Respiratory Diseases, by A. Little, Poultry Expert.

Selection and Preparation of Fowls for Exhibition, by H. G. Wheeldon, Poultry Expert.

The Close of the Hatching Season and After, by H. G. Wheeldon, Poultry Expert.

7/38. No. 1075. The Artificial Incubation, Brooding and Rearing of Chickens, by H. G. Wheeldon, Poultry Officer.

11/38. No. 1090 A Cheap Portable Colony House for Poultry, by G H Cooper, Assistant Poultry Officer.

12/38. No. 1092 Feeding and Drinking Appliances for Poultry, by G H. Cooper, Assistant Poultry Officer

METEOROLOGICAL.

12/22. No. 436. The Possibility of Seasonal Forecasting and Prospects for Rainfall Season, 1922-23, by C. L. Robertson, B.Sc., A.M.I.C.E.

12/24. No. 524. The Use of an Aneroid Barometer, by C. L. Robertson, B.Sc., A.M.I.C.E.

2/25. No. 532. The Short Period Forecast and Daily Weather Report, by C. L. Robertson, B.Sc., A.M.I.C.E.

6/25. No 542. Review of the Abnormal Rainfall Season, 1924-25, by C. L. Robertson, B.Sc., A.M.I.C.E.

10/28. No. 712. The Time, and How to Find It, by N. P. Sellick, M.C., B Sc. (Eng.).

10/31. No. 832. The Weather Map and the Short Period Weather Forecast, issued by the Meteorological Office.

2/33. No. 877. Clouds and Weather in Southern Rhodesia, by N. P. Sellick, M.C., B.Sc., Meteorologist.

3/35. No. 948. The Weather, contributed by The Meteorological Office.

AGRICULTURAL BUILDINGS.

9/25. No. 554. Pisé-de-Terre, by P. B. Aird.

4/26. No. 588. Concrete on the Farm, by N. P. Sellick, M.C., B.Sc. (Eng.), Assistant Irrigation Engineer.

8/26. No. 605. Flue-curing Tobacco Barns. Bulking and Grading Sheds, by P. H. Haviland, B.Sc. (Eng.), Acting Government Irrigation Engineer.

5/27. No. 644. Tobacco Baling Boxes, by B G. Gundry, Irrigation Branch.

11/27. No. 661. Flue-curing Tobacco Barns, 12 ft. x 12 ft. x 16ft., by B. G. Gundry.

10/32. No. 863. Piggeries, by B. G. Gundry, A.I.Mech.E.

5/33. No 889. The Construction of Dipping Tanks, by B. G. Gundry, A.I.Mech.E.; and Notes on their Management, by J. M. Sinclair, M.R.C.V.S., Chief Veterinary Surgeon.

9/33. No. 902. Brick-making on the Farm, by A. C. Jennings, Assoc.M.Inst.C.E.

12/33. No. 908. A Charcoal Safe or Cooler, by B. G. Gundry, A.I.Mech.E., Irrigation Division.

5/34. No. 922. Dairy Building in Southern Rhodesia: A Small Farm Dairy, by B G. Gundry, A I.Mech.E.

7/34. No 926. Dairy Buildings in Southern Rhodesia. Cow Byre—Type II, by B. G. Gundry, A.I.Mech.E.

8/36. No. 996. The "Gundry" Tobacco Furnace, by B. G. Gundry, A.I.Mech.E.

10/36. No. 1002. A Simple Farm Gate, contributed by the Division of Forestry.

5/37. No. 1031. Cattle Bale Grip.

8/37. No. 1041. Feeding Pens for Bullocks: the Layout at Estes Park, near Salisbury.

CHEMISTRY.

12/29. No. 762.—The Value of Rock Phosphate and "Bone and Super phosphate" as Fertilisers for Maize Production, by A. D. Husband, Chief Chemist.

4/32. No. 852. Mixing of Fertilisers: A Guide to Methods of Calculation, by the Division of Chemistry.

7/32. No. 858. The Softening of Waters, by the Division of Chemistry.

1/34. No. 910. The Toxicity to Grazing of Grass Sprayed with a Solution of Sodium Arsenite, by A. D. Husband, F.I C., and J. F. Duguid, M.A., B Sc.

9/34. No. 930. Analyses of Rhodesian Foodstuffs, by The Division of Chemistry.
Chemist.

5/35. No. 954. Experiments on the Toxicity to Fowls of Arsenite of Soda and Poisoned Locusts, by J. K. Chorley, F.R.E.S., and R. McChlery, B.A., B.Sc.

4/36. No. 983. Annual Report of the Branch of Chemistry for year ending 31st December, 1935, by A. D. Husband, F.I.C., Chief Chemist.

7/37. No. 1035. Analyses of Rhodesian Foodstuffs, by The Division of Chemistry.

MISCELLANEOUS.

4/28. No. 686. The Land Bank, Its Functions and How it Operates, by S. Thornton.

4/28. No.. 687. The Use of Explosives on the Farm, by P. H. Haviland, B.Sc. (Eng.).

7/28. No. 702. Book-keeping on the Farm, by T. J. Needham, Acting Accountant, Agricultural and Veterinary Departments.

9/28. No. 707. Wood-Charcoal in Southern Rhodesia, by T. L. Wilkinson, B.Sc., Assistant Forest Officer.

5/31. No. 820. The Great Economic Problem in Agriculture—No. 1, by J. R. McLoughlin, M.Sc. (Economics), Economic Adviser.

6/31	No	823	The Law of Supply and Demand—No. 2, by J. R. McLoughlin, M.Sc. (Economics), Economic Adviser.
			Twelve Simple Rules for the Avoidance of Malaria and Blackwater.
			Summary of the Game Laws of Southern Rhodesia.
11/34.	No	935	The Weeds and Poisonous Plants of Southern Rhodesia, by Chas. K Brain, M.A., D.Sc, Director of Agriculture. Part I.
8/35.	No.	961	A Home-made Ridger. Contributed by Mr. Douglas Aylen, Somerset, Concession.
1/36.	No.	975	Fertilizers, Farm Foods, Seeds and Pests Remedies Ordinance, 1914.
2/36.	No.	979.	The Prospects of Black Bass in the Inland Waters of Southern Rhodesia. Specially contributed
6/36	No.	991.	Silage and Silos
8/36.	No	997.	Reward Wheat: Report on the Baking Properties and Chemical Analyses, by The Rhodesian Milling and Manufacturing Co, Ltd
8/36	No.	998	Summary of the Game Laws of Southern Rhodesia.
3/37	No.	1018.	Veld Fires The "Forest and Herbage Preservation Act, 1936," by E J Kelly Edwards, M.A., Dip. For. (Oxon), Chief Forest Officer
3/37.	No	1021	Breaking in Young Oxen to the Yoke, by J. B. West, Dromoland, P B. Lonely Mine.
6/37.	No	1033	Compost. A Note on Methods of Reducing the Costs, by S. D Timson, M C., Assistant Agriculturist.
7/37.	No.	1038.	Star Bur-weed (*Acanthospermum austiale*, O. Kuntze), by Chas. K. Brain, D Sc., Director of Agriculture.
8/37.	No.	1042	Weeds of Southern Rhodesia. Part II. By Chas. K. Brain, D Sc., Director of Agriculture.
9/37.	No.	1044.	Farming Calendar.
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11/38.	No.	1089.	Witchweed and the Labour Shortage, by S D. Timson, M C., Assistant Agriculturist.
12/38	No.	1093.	Cattle Bale or Grip

NOTICE

The Agricultural Journal of S. Rhodesia

is issued by the Department of Agriculture, and can be obtained upon application to the Editor. The Annual Subscription, which must be paid in advance, is 5/-, and payment may be made by any means other than by stamps.

A 10/- note will cover the subscription for two years.

Persons residing outside Southern and Northern Rhodesia may become subscribers by paying 2/- in addition to the subscription, to cover postage.

If payment is made by a cheque drawn on a bank outside Rhodesia, commission must be added.

All cheques and postal notes must be made payable to the Secretary for Agriculture and Lands.

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THE RHODESIA

Agricultural Journal

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(Assisted by the Staff of the Agricultural Department).

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Editorial.

Contributions and correspondence regarding subjects affecting the farming industry of Southern Rhodesia are invited. All communications should be addressed to:—The Editor, Department of Agriculture, Salisbury. Correspondence regarding advertisements should be addressed:—The Art Printing Works, Ltd., Box 431, Salisbury.

Meat Research in South Africa.—A new laboratory for meat research has been completed at Onderstepoort at a cost of over £30,000 and work will begin there this month. Most of the officers who will work there have recently visited Europe and made a careful study of the most modern methods employed in the slaughter of animals and the refrigeration and examination of meat for the largest markets of the world. The new laboratory is probably the most completely equipped institution of its kind in the Southern Hemisphere.

In the abattoir division, where each animal will be watched from the time it arrives at the institution to the time its carcase is ready for the markets, every modern facility has been furnished, one of the most interesting being the rounded corners of the piping in the pens, which are of improved

design. The absence of projections of any kind is intended to avoid bruising and to allow the animals to enter the slaughter-house in perfect condition.

The refrigeration division provides comprehensive facilities for preserving various kinds of meat and slaughter-house by-products for export and for the local markets. The plant has been installed in the basement of the building, from where air, cooled by a brine-cooling system, is conveyed to the chambers by an elaborate system of pipes in such a way that temperature, humidity and ventilation are at all times under automatic control. Provision has also been made for the preservation of meat by means of carbon dioxide gas if the occasion arises.

It will be the aim of the institution to experiment with all possible types of refrigeration in order to find the most satisfactory method.

Specimens of meat, it is expected, will be sent to various South African and overseas stations for further examination.

A chemical laboratory, a physiological laboratory and a cooking room have been furnished in the research department. In the cooking room meat will be cooked in an elaborate electric stove to test its tenderness, palatibility and other qualities.

The institution, the work of which will be co-ordinated with that of the other divisions of the Department of Agriculture, represents one of the most important developments at Onderstepoort in recent years.

Aberdeen Angus Lead at Smithfield Again. According to reports published in the British agricultural journals Aberdeen Angus cattle again dominated this year's Smithfield Fat Stock Show. This breed and its crosses furnished not only the winners but also the reserve animals of all the inter-breed trophies. The weight-for-age figures are of particular interest. The champion animal of the show, Lady Robinson's "Magnolia of Kirklington," weighed just on 1,600lbs. at two years and 11 months, and ended her show career by being bought by a firm of Glasgow butchers for £165. Reserve positions for the two supreme championship contests were also filled by

pure-bred Angus, a steer scaling 1,546lbs. at two years and six months, and a heifer weighing 1,162lbs. at one year and nine months. The best steer over 15 months and under two years, a Shorthorn-Angus first-cross, scaled 1,600lbs. at one year 11 months; the best steer or heifer 15 months and under, a pure-bred Angus, made 902lbs. at 11 months and four weeks; and the best heifer above 15 months and under two years, a pure-bred Angus, weighed 1,162lbs. at one year and nine months.

Notice to Farmers.—Farmers requiring advice during the coming year on matters relating to soil conservation, irrigation and water conservation schemes, are requested to send in their applications for visits as soon as possible, to the Director of Irrigation, Box 387, Salisbury, or if in Matabeleland, to the Irrigation Engineer (Matabeleland), Box 566, Bulawayo.

Farmers are particularly requested not to apply direct to an engineer while on tour, unless previous application has been made to one of the above addresses. Visits of this nature make it impossible for him to adhere to the dates given to other farmers before the commencement of his tour.

No charge is made for visits if carried out in the course of a tour, provided they do not occupy more than one day.

It is hoped that farmers will endeavour to co-operate with the Department by observing the above points, so that disappointments may, as far as possible, be avoided.

The Curing of Ginger.—The following notes taken from *Tropical Agriculture*, the Ceylon Journal, may be of interest.

Of the two methods of curing ginger (1) sulphur curing, (2) ordinary curing, the former, which had a number of advantages over the ordinary curing, has now to be discontinued owing to the regulations introduced in most importing country prohibiting the sale of ginger containing sulphur dioxide. An investigation was made by the Department of Agriculture, Ceylon, to discover whether equally good samples of ginger could be prepared without the use of sulphur. The most suitable variety was found to be the Cochin, which if

cured in the proper way gives a plump light buff coloured product of good aroma, flavour and fracture. A period of eight to ten days of sunshine is essential for curing. If rain falls on the ginger during this period, mould and a musty flavour are developed which no amount of washing and drying will eliminate. To obtain a light coloured product curing should begin as soon as the crop is harvested. If more than is required for a day's peeling has to be harvested, the rhizomes should be placed in a well-aired room in small heaps, dry soil being spread over successive layers of ginger. As soon as harvested the ginger is first washed to remove all earth and then soaked in clean water till the following morning. Peeling is the next operation, and this may be either rough peeling for the local market or clean peeling for the English market. Clean peeling is expensive and only 10-14 lb. per day can be cleaned by one peeler. As soon as peeled the rhizomes are placed in water and the gummy exudation removed by washing. Several more washings and soakings are given, as this is one of the most important operations in ginger curing. When washing is complete the ginger is spread on cement or bamboo tables to dry, rock slabs being better still. Drying takes 5 or 6 days, during which time the ginger must be turned several times daily. When quite dry the ginger is washed again, a process which improves the colour considerably. This washing is only used with clean peeled ginger for the foreign market. The final drying takes 3-4 days. Crude peeled ginger in India is sometimes soaked in a mixture of red earth and whitewash and then dried. This prevents the growth of mould.

Covers for the 1938 Journal.—Cardboard covers, with printed slip for the 1938 volume of this Journal, may be obtained from the Art Printing Works, Box 431, Salisbury, for 1s. 9d. post free. The covers are hinged with cloth and punched to match the holes in the Journals. When put in position string is passed through the holes and tied and the gummed cloth strip is then stuck on the back and the printed label fixed in position. These covers are also useful for binding bulletins reprinted from the Journal. It should be noted that copies of the ordinary Departmental bulletins are

now supplied to residents of Southern Rhodesia free of charge. Persons resident outside the Colony still have to pay 3d. per copy.

Cleanliness Hints for February.—Burn tobacco primings and unthrifty plants. Dig over seed-beds. Clean the grading sheds regularly and destroy rubbish at once. Collect and destroy fallen and stung fruit. Destroy weeds. Cut soiled wool from sheep suffering from scour. "Cleanliness Aids Insect Control."

Cattle for the Export Market.—The Cold Storage Commission of Southern Rhodesia has, in terms of section 10 (2) (a) of the Cold Storage Commission Act, 1937, with the approval of the Minister of Agriculture and Lands, fixed the following prices to be paid for the periods stated by the Commission for cattle purchased other than at public auction, the carcases of which shall be exported in the form of chilled meat:—

1939.	Imperial Grade	Standard "A" Grade	Standard "B" Grade.
January	35/-	32/-	27/6
February	32/-	29/-	24/6
March	30/-	27/-	22/6
April	30/-	27/-	22/6
May	30/-	27/-	22/6
June	31/-	28/-	23/6
July	32/-	29/-	24/6
August...	33/-	30/-	25/6
September	34/-	31/-	26/6
October	35/-	32/-	27/6
November...	35/-	32/-	27/6
December...	35/-	32/-	27/6

These prices will be paid per 100 lbs. on the cold dressed weight delivered at the Commission's works in Bulawayo. Cattle purchased out of hand will be paid for on the above basis, less railage or cost of delivery, cost of purchasing and allowance for condemnations and rejects.

Undergrade beef derived from cattle of indiscriminate age but in prime condition will be paid for at a price of 22/6 per 100 lbs. cold dressed weight.

Imperial Agricultural Bureaux.—Although the chief aim of the Imperial Agricultural Bureaux is to serve the scientist, some of their publications are of considerable interest to the practical farmer. A selection is given below. These publications can be obtained from the Secretary to the Executive Council, 2, Queen Anne's Gate Buildings, Dartmouth Street, London, S.W.1. Prices include postage.

Organic Manures	2/-
Tropical Soils in relation to Tropical Crops ...	2/6
Erosion and Soil Conservation	5/-
Soil Structure	2/-
Problems of Animal Nutrition and Animal Husbandry in Northern Nigeria	1/-
Recent Research in Poultry Nutrition	1/-
Composition of some African Foods and Feeding-stuffs	1/-
Problems of Fruit Tree Nutrition, 1933	2/-
The Frameworking of Fruit Trees, 1938	1/-
Nutrition and Manuring of Small Fruits, 1936 ...	2/-
Vegetative Propagation of Tropical and Sub-Tropical Fruits, 1936	2/-
Plant Injection for Diagnostic and Curative Purposes, 1938	5/-

The practical fruit grower will often find interesting matter in the quarterly periodical, "Horticultural Abstracts." Annual subscription in Empire countries, 20/-. Single copies 5/- each.

Animal Breeding in the British Empire	2/-
Inheritance of Productivity in Farm Stock (Reprint)	6d.
The Genetics of the Pig (Reprint)	2/6
The Bursate Lung-worms of Domesticated Animals	5/-
Helminthology in its Application to Livestock ...	1/-
Helminthology in its Application to Agriculture and Horticulture	1/-

Diseases of Tobacco in Southern Rhodesia.

(Supplement I. 1932 to 1938.)

By J. C. F. Hopkins, D.Sc. (Lond.) A.I.C.T.A.,
Senior Plant Pathologist.

(Continued.)

PARASITIC DISEASES IN THE FIELD.

Fungous Diseases.

Mildew or White Mould (*Erysiphe cichoracearum*, DC.).

Now that the Hickory Pryor variety has lost favour with growers and has been replaced by the more resistant Orinoco White Stem, Willow Leaf, Jamaica Wrapper and so on, mildew has become of much less importance in Rhodesia.

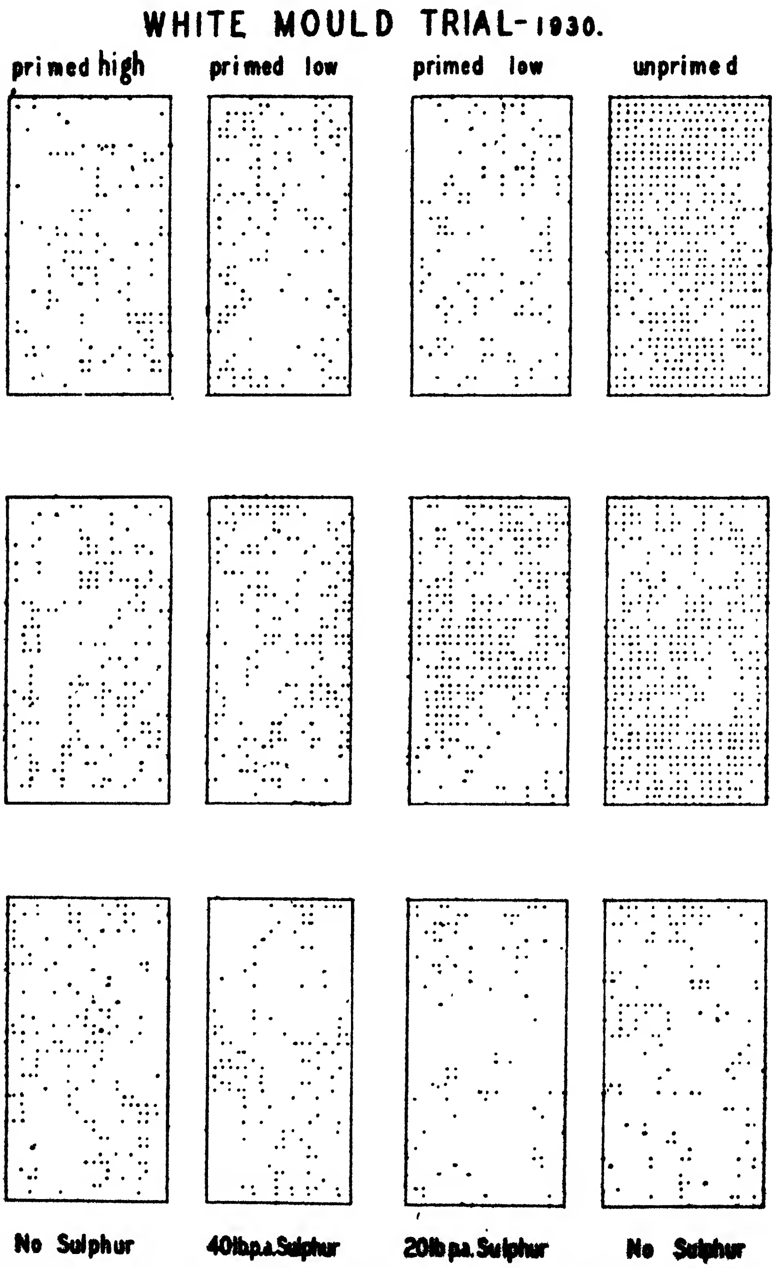
Again, priming is practised much more generally to-day than it was a few years ago, and this has had the effect of reducing the amount of mildew in the crop.

Occasional reports are received of severe damage done by this disease, and the reasons for the sporadic outbreaks have not been explained.

It now seems certain that aeration of the plants gives a satisfactory measure of control and the use of fungicides, such as powdered sulphur, is not considered to be economically practicable.

Control.—Text fig. 3 shows diagrammatically the effect of aeration and sulphur on mildew control. The rectangles represent field plots laid out in triplicate, each series of four occupying 1 acre. The dots represent plants infected with mildew at the time of reaping.

It will be seen that there is much less infection in all treatments in the lower series of plots, and this is considered



Text Fig. 3.—Diagram of white mould control experiments. Each dot represents an infected plant.

to be due to poor growth of the plants resulting from infertility of soil. No crowding of leaves took place in these plots so that ventilation was ample.

In the other two series, both high priming and sulphur, with or without priming, reduced the incidence of mildew as compared with the controls. In the latter, one early priming was given and the plants were allowed to grow without further treatment. In the high primed plots, leaves were removed three times, leaving a bare length of stalk varying between 6 inches and 1 foot above the ground, according to the size of the plant. The low primed plants had two primings. Topping was adjusted as far as possible to leave eleven leaves per plant.

No opportunity has been found of investigating this disease on Turkish tobacco.

FROG EYE (*Cercospora nicotianae* Ell. and Ev.).

Although this disease was dealt with at some length in the Departmental handbook, its occurrence is still general and it is responsible for a greater annual loss to the tobacco industry than any other disease. The usual symptoms have already been fully described, but an abnormal type of frog-eye sometimes develops[4] on very light leaf during spells of drought following very wet weather.

Description.—As a result of uninterrupted cold, wet periods newly planted tobacco does not make the accustomed rapid growth, and nearly everywhere the plants become yellow in colour. Not uncommonly the young plants are covered by weeds which have been allowed to get out of hand. It is not surprising, therefore, to find the lower leaves severely attacked by leaf spotting organisms, chief among which is the frog-eye fungus. The typical brown, white-centred spots are numerous and conspicuous on the upper leaves, but are fewer in number and not easily detected lower down the plant. Instead are to be found large chestnut-brown blotches which, in the case of plants surrounded by weeds, encroach upon and finally destroy the almost white bottom leaves, leaving them as limpid brown shreds hanging from the stalk. Frog-eye in this form does not usually occur in the field, but is comparable with the

disease as it appears on the lower leaves of seed-bed plants which have been allowed to become chlorotic, either as a result of excessively thick sowing of seed or fertiliser deficiency.

During the interval between the cessation of rains and the ripening of the crop, if a severe drought is experienced the development of the lower leaves is not completed before they begin to turn colour. In other words, the leaves do not ripen normally, but merely become chlorotic (yellow) as a consequence of impaired metabolism. Such leaf is deficient in gum, thin in "body" and possesses a harsh texture. As is usual under conditions of drought, the tissue between the main veins of the leaves dies, causing the symptoms of "sun scorch," "firing" and "drought spot" to appear.

The lesions range from one-eighth of an inch to one inch in diameter, are chestnut brown in colour, with very thin dark brown margins and small dark brown central areas. Indistinct zonations may also be present. Very rarely the central areas are lighter in colour than the immediately surrounding dead tissue, and sometimes broad, bright yellow bands occur between the spot and the green tissue. Other leaves may show large circular or elongated light brown lesions with pronounced zonations, and small dark centres, in which can be seen, with the unaided eye, an almost black, powdery mass of fungus spores (Pl. 2 fig. 4). The spots are not surrounded by bands of bright yellow, although the cells bordering the dead areas are somewhat chlorotic.

Microscopic examination proves the two types of spot to be caused by the same organism, namely, the frog-eye fungus, and it is very interesting to note that not only are the symptoms of the disease abnormal, but the fungus itself produces spores and spore-bearing branches of unusual dimensions.*

Conditions favouring the disease.—It is well known that frog-eye becomes widespread when wet periods of weather are

*The measurements for conidiophores are 30 to 50 x 4 to 6 microns. and for the conidia 50 to 65 x 3 to 5 microns. Conidiophores and conidia of the same dimensions are observed on a few typical frog-eye spots which occur on the abnormal material. My measurements for the conidiophores of normal *Cercospora nicotianae*, as it occurs in Rhodesia, are 75 to 100 x 4 to 5 microns, and for the conidia 38 to 135 x 2.5 to 3 microns.

experienced shortly before reaping commences, but it has been demonstrated on many occasions that no serious epidemic occurs if the bottom leaves of the plants are relatively free from frog-eye spots before the wet weather sets in.

If priming is delayed until the bottom leaves become yellow and show a large number of frog-eye lesions, there is always the danger of the disease developing rapidly so that it keeps ahead of reaping.

The fungus commences to produce spores shortly before the centres of the spots turn white, and these spores are very soon blown about the field where they alight on and infect clean leaf. The normal resistance of green leaf is lowered as soon as it commences to ripen which, combined with the dispersal of a large number of spores from spots on the lower leaves, accounts for the apparently sudden outbreaks of the disease which are so common in Rhodesia.

In the barns it has been found that temperature has a considerable effect on the development of frog-eye. If curing is commenced in the usual way at 90° F., the spores of the fungus, which have been brushed from infected spots on to clean leaf, germinate and grow through the tissues, causing the well-known barn spots, which appear when temperatures are raised. If, however, curing is commenced at 100° F. it is found that very few barn spots appear, even though the atmosphere is saturated, as it must be in order to prevent scorching and allow colouring to proceed.

Control.—In the seed-beds it has been shown that regular spraying with copper compounds, such as Bordeaux mixture (4-4-50) or colloidal copper (5 lb. to 100 gallons water) every five days from the time that the first leaves are the size of a shilling right up to transplanting, gives complete protection against frog-eye. The spraying must be continued whilst the plants are being "hardened off," otherwise some infection will occur.

In the field, successful control depends entirely on priming. Bottom leaves must not be allowed to remain on the plants until they are yellow and covered with spots, but must be removed before the spots appear, or taken from the land if showing signs of infection. Decaying primings left in the

furrows and showing frog-eye spots have been examined at different stages, and it has been observed that the fungus continues to produce viable spores up to the time when the leaf is almost disintegrated. Spores taken from such material, which has been subjected to drying on the ground for several weeks, have germinated after a few hours in the laboratory when placed in sterile water.

In the barns, the black spotting may be prevented by commencing curing at a temperature of 100° F. in a saturated atmosphere.

It has been reported by different workers that frog-eye is a seed-borne disease. No evidence of this has been obtained under Rhodesian conditions where seed heads are selected and bagged whilst the plants are in flower. That the disease is air-borne is, however, almost certain, because of its inevitable appearance on plants raised from treated seed in beds which have been sterilised, situated at considerable distance from tobacco refuse at a time when no growing tobacco is in existence. Furthermore, the disease always occurs in crops planted in newly-stumped land as well as in old fields.

Complete control is therefore largely dependent upon field sanitation and the destruction of all infected tobacco refuse (Pl. 2 fig. 5).

Brown Stem Rot (*Phytophthora parasitica* Dast. amend Ashby).

Mycelium coarse, torulose with clavate and globose branches. Sporangia (in sterile water) large, papillate 32 to 52 x 29 to 41 microns, with a length/breadth ratio of 1.3. Chlamydospores numerous in potato dextrose agar, spherical, 21 to 39 microns diameter, with a thick yellow wall. No oospores seen.

This disease has only been encountered twice on tobacco. It is, however, common on certain garden plants such as *Antirrhinum*, *Clarkia* and *Godetia*. The connection between the disease on tobacco and *Antirrhinum* was establshed by me in 1931([8]).

Description.—Brown stem rot has not been found in seedbeds and is superficially indistinguishable from black stem rot in the field. Affected plants show the usual sign of wilting,

Plate 2 Fig 5.—Appearance of drought resistant frog-eye fungus on surface of leaf spot x 420.

Plate 2 Fig 4 —Abnormal type of frog-eye spot.

the lower leaves being yellow, with reddish brown blotches of dead tissue.

The fungus attacks the base of the stem, causing a brown depressed lesion to form. Later the internal tissue collapses and infection spreads to the wood and pith. The visibly infected area elongates and may extend to as much as a foot above soil level, when the stalks of some of the lower leaves are invaded.

The wood becomes stained and a brown rot is set up in the pith, which sometimes is divided into horizontal discs, but more frequently rots away to leave a hollow cylinder. The coal black rot associated with "black shank" and reported by Butler([8]) from Nyasaland has not been observed with this disease.

Conditions favouring the disease.—Brown stem rot has only been found in Rhodesia affecting tobacco growing in waterlogged soil. Experiments carried out in 1930 showed that excessive soil moisture was a necessary factor for fungal infection.

The disease on garden plants may be brought about by irregular water supply, especially if the soil is allowed to become so dry that partial wilting takes place. This is especially so in the case of transplants.

It was also found in pot experiments that plants with tough stems were more resistant than those with sappy stalks.

Control.—If tobacco is planted in well-drained soil of suitable fertility, no control measures have been found to be necessary.

BLACK STEM ROT (*Phythium aphanidermatum* (Edson) Fitzpatr.).

Mycelium coarse and frequently swollen in the cortical tissues, up to 7 microns in width. Presporangia irregular, clavate or branched, cut off at the hyphal ends, up to 800 x 20 microns. Sporangia clavate or globose. Oospores, in oatmeal agar, colourless, 14 to 22 microns diameter with smooth wall about 3.5 microns thick.

In the Departmental handbook, a stem rot in which a certain amount of blackening took place was described and attributed to a species of *Rhizoctonia*. It is possible that the

first recorded disease was identical with the black stem rot which is now attributed to *Phythium aphanidermatum*.

Butler[6] in 1928 described a stem rot from Nyasaland which he attributed to this fungus, and what is apparently the same disease was reported in 1922 from Sumatra[18] causing almost complete destruction of transplants. A similar disease was reported in 1923 by Bunting and Dade from the Gold Coast[19], but the earliest record on tobacco was at Pusa about 1916[20].

Description.—The disease usually makes its appearance first of all in the seed-beds, where it causes a "damping-off" of plants of all sizes. The general symptoms are the usual wilting and death caused by the fungus invading the tissues of the stem at soil level.

But in the case of black stem rot, the final stage of affected plants is a jet black, slimy mass (Pl. 1 fig. 1) which contrasts with the pale coloured plant remains characteristic of other "damping-off" diseases (Pl. 1 fig. 2).

Plants ready for setting out may be already infected at the collar without showing any visible signs of wilting, and when this is the case many are, of course, transplanted. If conditions are at all unfavourable and the plants do not establish themselves quickly, then the fungus continues to develop, extending upwards in the stem towards the leaves. In a short while a soft rot develops throughout the whole stem, the plant collapses and is reduced to a wet, very dark or jet black mass. Heavy losses necessitating replanting of whole lands have resulted from this phase of the disease.

Some plants may survive although still infected. They continue to grow under favourable conditions to a good size. If then a period of wet weather sets in, the fungus in the stem again becomes active and the infected area extends, causing the appearance of depressed, dark brown or black patches at the base of the stalks.

Beneath these patches the tissues are jet black and a brown discolouration of the woody part of the stem occurs. In the centre the pith may be brown or black and is usually divided up by transverse discs, the spaces between the discs

being hollow. "Discing" of the pith also occurs in association with other stem diseases and does not appear to be diagnostic for this fungus.

By this time affected plants show the usual symptoms of stem or root diseases, namely, wilting, with yellow and brown discoloration of the lower leaves. They are superficially indistinguishable from plants affected by the nematode, *Heterodera marioni*.

Conditions favouring the disease.—In seed-beds, wet conditions caused by inadequate drainage, over-watering or prolonged rainy weather favour attack by the fungus. After transplanting the disease may develop rapidly on plants which fail to establish themselves as a result of hot, dry weather following removal from the seed-beds. "Lanky" seedlings with long stems are also more susceptible than shorter, more robust plants.

Control.—As the causal fungus is a soil inhabiting organism, the first precaution to be taken is seed-bed sterilisation.

Overcrowding of seedlings not only makes conditions more suitable for the development of the disease, but also produces the type of "lanky" plant which is more susceptible after being set out in the lands. Thick sowing of seed-beds should therefore be avoided.

Care should be taken in the choice of seed-bed sites to see that the beds are well drained, and over-watering should be avoided.

Regular spraying with Bordeaux mixture at 4-4-50 strength does not appear to prevent the disease, but considerable success has been obtained by sprinkling dry Bordeaux powder on and around infected patches of plants. The use of Cheshunt compound is also recommended (see Care of Seed-beds).

When setting out in the lands, care should be taken to see that only healthy plants are selected, and if black stem rot is known to occur in any particular land, transplanting into this area should only be done when conditions are very favourable for the growth of tobacco.

Virus Diseases.

MOSAIC.

Little more can be added to what was written in the Departmental handbook about mosaic.

That several viruses of the mosaic group affect tobacco in Rhodesia is fairly certain, but the symptom expression of various virus complexes remains to be worked out.

Control.—So far there is no evidence to suggest that mosaic diseases are introduced to Rhodesian grown tobacco by insects, so that control still depends almost entirely on reducing the handling of plants to a minimum.

Beds should be sown so that there is no necessity for thinning out later on and the soil should be burnt to kill weed and grass seeds.

When plants are pulled, the boys' hands should be washed from time to time in soap and water and the water changed frequently. Tobacco smokers or boys who take snuff should, as far as possible, be kept from the seed-beds.

Washing of hands should also be done when planting out, but the water must be changed often otherwise the concentration of the virus in solution may become so great that it is infectious.

Priming should be delayed until the seedlings have put out several leaves when mosaic infected plants can be detected. They should be pulled out before priming is started, but the holes should not be refilled, as it has recently been shown in America that there is a danger of the "supplies" becoming infected from the soil. If normal precautions are taken, the amount of mosaic present before priming takes place should be negligible and roguing will have little effect on the stand.

At the second priming mosaic infected plants should again be rogued, but if the percentage is so high as to noticeably affect the yield if pulled out, they should be primed by special boys detailed for the purpose. It is a dangerous practice to leave these plants unprimed owing to the danger of creating a source of frog-eye infection.

Pate 4 Fig. 9 —Half-grown tobacco affected by rosette

Plate 4 Fig. 10 —Circular patch of early infected rosette plants contrasting with late infected plants in the background. The infected area is enclosed by dotted line.

Whilst priming is being carried out washing of boys' hands should be done in the same way as recommended for planting.

In order to prevent the use of infected snuff, the question of issuing specially prepared snuff rations to boys has been considered. If this snuff is made from fermented and heated leaf, the origin of which is known, the chances of mosaic infection remaining are remote. Samples of commercial snuff tested in the Plant Pathology laboratory were found to be uncontaminated by mosaic.

Rosette.

Caused by the rosette (Wickens. 1938) virus. It is not sap transmissible. Vector is *Myzus persicae*, Sulz.

This disease, which has only recently been discovered by Wickens([10]), is new to Rhodesia and possibly to science. It was first observed on one farm in the Umvukwes in the season of 1936-37 and has now spread to most of the tobacco growing districts of the Colony. It is transmitted from diseased to healthy plants by greenflies (aphids).

Description.—Symptoms of rosette vary considerably, but they appear to be determined more by the age of the plant and time of infection than by environmental conditions or variations in the virus itself.

Plants which are infected when about two or three feet high cease upward growth abruptly and the bud and young leaves become violently puckered, curled and generally distorted. The older, well developed leaves at the base of the plant retain their normal shape and habit of growth, so that the disease imparts to the palnt a rosette appearance if viewed from vertically above downwards. Typical symptoms of a severely attacked plant are shown in Pl. 4 fig. 9.

If infection occurs late in the season after flowering has begun, the severe distortion of leaves does not normally take place. Instead, they take on a hooded appearance due to the downward drooping of the margins and tips. Such leaves are usually lacking in "body" and of a lighter colour than those more severely affected. In addition, the main veins assume a wavy appearance somewhat suggestive of leaf curl on very "light" plants.

Wickens[11] refers to distortion of the stems due to cessation of growth on one side and also to the sudden curling under of the leaf tips. The symptoms seem to be the expression of a necrotic strain in the virus, which causes small localised spots of vascular tissue to die suddenly. When a portion of the leaf midrib or a main vein is thus affected, longitudinal growth ceases at once on the under side, but continues on the upper surface. The result, of course, is a rather charactesristic bending of stem and leaf.

After growth has continued for some time and considerable bending of the leaf has taken place, it will often be found that small leafy outgrowths (or enations) appear across the angle of the midrib formed by the necrotic lesion.

Although the leaves do not react a great deal to late infection, yet a rather serious phase of rosette is its effect on flowering and seed production. Usually the flowers and flower stalks of infected plants are more or less severely twisted, and a good number are shed early. Sometimes all flowers or young seed capsules drop off and no seed is produced by the plant. On farms where infection was general last year, growers had some difficulty in obtaining enough seed for their requirements. From observations made this season on some of these farms, it seems unlikely that the disease is seed-borne or that the seed is seriously affected by the virus.

Rosette has been found in seed-beds both this year and last year. Several cases of rather heavy infestation of seed-beds by aphids without the appearance of the disease have also been reported.

The first symptom on young seedlings is a slight curling downwards of the tip of one of the youngest leaves just emerged from the bud. The plant continues to grow and the affected leaf begins to pucker up as shown on Pl. 5 fig. 11. Subsequent leaves grow in the same way, the distortion becomes more accentuated, and eventually a rosette of twisted and puckered leaves forms in the crown of the plant and growth is arrested.

Where infected aphids have gained access to seed-beds and have fed upon the seedlings, a number of these diseased plants will be observed. This is particularly the case in early

Plate 5 Fig 11 — Rosette in tobacco seedling

Plate 5 Fig 12 —Rosette in young plant of *Solanum nigrum*

beds from which plants have been pulled for setting out in the lands, the remainder having been left for "supplies."

Conditions favouring the disease.—As with leaf curl, any conditions which favour the development of the insect transmitting rosette will favour the spread of the disease.

Already it is known that a number of common plants are susceptible.. Some are cultivated, some wild. Among the cultivated are tomato, potato and probably Zinnia, whilst wild hosts include the small nightshade or Sobee (*Solanum nigrum*) (Pl. 5 fig. 12) and the chinese lantern plant or false cape gooseberry (*Nicandra physaloides*).

As this particular greenfly has a very wide host range and is known to be a very efficient carrier of viruses, it seems highly probable that the alternate host range of the virus is also large.

Control.—As little is at present known of tobacco rosette and the behaviour of *Myzus persicae* in Rhodesia, recommendations for control of the disease must necessarily be of a tentative nature. There are two obvious lines to follow, one is the eradication of sources of virus infection and the other the destruction of greenfly.

Apart from following the spraying recommendations, growers are urged to be particularly vigilant in seeking out seedlings infected with rosette. Diseased plants should be pulled out at once and buried deeply or burned, so as to destroy not only the affected plant, but also any aphids with which it may be infested. For it must be remembered that any greenflies escaping from an infected plant and invading a seed-bed will without doubt infect a good number of healthy seedlings. It will not be out of place to emphasise once again the fact that the aphis, *Myzus persicae*, is known to be an extremely efficient carrier of rosette.

With this in mind, it is necessary to consider the question of alternate host plants, including susceptible weeds.

Tomatoes, zinnias and potatoes are common garden plants, the first two often being grown near to seed-bed sites. Sobee and false gooseberry are usually to be found growing in vleis or on organic matter near seed-beds, and the latter

can always be found in abundance near to cattle kraals. It is of utmost importance that these weeds should be kept down on all parts of tobacco farms and that tomatoes, potatoes and zinnias be grown as far as possible from tobacco seed-beds and lands.

In urging the eradication of over-wintering host plants, sight must not be lost of the most obvious and dangerous of all, namely, ratoon tobacco. Thorough cleaning of lands and the continual removal of re-growth is now of greater importance than ever, for one dirty land may spell disaster not only for the owner, but also for his neighbours.

Recommendations for the control of tobacco rosette may be summarised as follows:—

1. Meticulous exclusion from fallow lands of all tobacco re-growth.

2. Removal from seed-beds and destruction of all seedlings showing symptoms of the disease.

3. Eradication of weeds, in particular false gooseberry and small nightshade or Sobee, from seed-bed sites.

4. Cessation of tomato, potato and zinnia culture in the neighbourhood of tobacco lands and seed-beds.

5. Control of aphis by spraying every five days with Bordeaux, arsenate of lead and nicotine mixture according to the following formula:—

Bordeaux	8 lb.
Arsenate of lead...	$1\frac{1}{2}$ lb.
Nicotine extract (40%)	16 fluid ozs.
Spreader	According to manufacturers' directions.
Water	50 gallons.

Spray should be applied with high pressure through a nozzle giving a very fine mist. Every reasonable effort should be made to wet the whole surface of each seedling. Admittedly perfection is more or less unattainable, but this is all the more reason for being as thorough as possible. The pressure behind a misty spray causes local eddies that assist in wetting the greater part of each plant. Where a suitable opening in

the dense foliage can be found or made, the nozzle should be poked amongst the seedlings so that the spray may reach the under sides of the leaves more directly. Aphids that are not hit by the spray will not be killed by it. Owing to the rapid breeding of aphids, one or two applications of nicotine are insufficient, and it is, therefore, necessary to add nicotine sulphate to the Bordeaux mixture that is normally applied every five days.

The inclusion of nicotine sulphate in the spray also assists in keeping down the tobacco whitefly (*Bemisia rhodesiaensis*, Corb.), the vector of leaf curl, but here again it is most important that the under sides of the leaves are reached.

In addition to nicotine sulphate and Bordeaux mixture, lead arsenate should be included in the spray. This insecticide reduces attack by split worm, leaf miner, leaf-eating insects, and to some extent cutworm. Split worm and leaf miner caterpillars are controlled by applications of lead arsenate only before the insects have burrowed into the plants. Once inside, they feed on the inner tissues and are no longer vulnerable to poison deposits that are confined to the surface. Insecticides made from derris root and pyrethrum may be used as a substitute for nicotine sulphate.

6. The destruction of all residual plants as soon as each bed is finished with.

LEAF CURL.

Caused by Nicotiana Virus 10 K M Smith The virus is not sap-transmissible or seed borne. Vector is *Bemisia rhodesiaensis*, Corb

This disease, which is now known to be of virus origin, was included in the Departmental handbook under the name of "Crinkle." At that time the true cause was unknown, although the presence of a virus was suspected.

Description.—The symptoms of leaf curl vary rather widely according to descriptions from various parts of the world (7), (8), (9), but under natural conditions of tobacco culture in Southern Rhodesia, the variation in appearance of infected plants is not great and depends principally on the age of the plant or the age at which infection occurs. Under artificial conditions of greenhouse culture or where infected

volunteer plants are growing in dense shade, there is much variation in leaf appearance. It seems, however, unnecessary to deal with these variations in detail.

The chief symptoms as they usually appear on field plants are a puckering or "savoying" of the leaves, which are usually of a dark green colour, accompanied by curling downwards of the leaf margins (Pl. 6 fig. 15). The leaves become brittle and the veins on the underside thickened. They may be detected easily if a portion of an affected leaf is held up to the sun and viewed by transmitted light, when the veins appear dark and opaque in contrast to those of healthy leaves, which are translucent. (Pl. 6 fig. 14.) A typical leaf curl plant is shown opposite p. 74 in the Departmental handbook.

If a plant is infected whilst still very young, it fails to make good growth and may develop little more than that shown in Pl. 6 fig. 15. If, on the other hand, infection occurs late in the season, then it may be the top leaves alone which become curled, although the fully formed lower leaves almost invariably thicken up and fail to cure out a good colour or texture.

It frequently happens, under these conditions, that vein thickening is undetectable by ordinary inspection and the new grower finds some difficulty in distinguishing between leaf curl and the somewhat similar rosette. However, the presence of greenfly (aphis) should in most cases serve to identify the latter.

Conditions favouring the disease.—As it is known that leaf curl is transmitted from diseased to healthy plants by whiteflies, it is obvious that conditions favouring the breeding up of the insects will also favour the spread of the disease.

The most common sources of infection in Rhodesia are abandoned tobacco lands in which infected ratoon plants are allowed to remain. As soon as the winter months have passed and daily temperatures rise, whiteflies appear on ratoon and volunteer tobacco plants in fallow lands. After a few weeks have passed these insects can be found in abundance feeding and breeding on the lower sides of any leaves which have developed, and within a very short time nearly all plants

Plate 6 Fig 13 - Ratoon tobacco affected by leaf curl

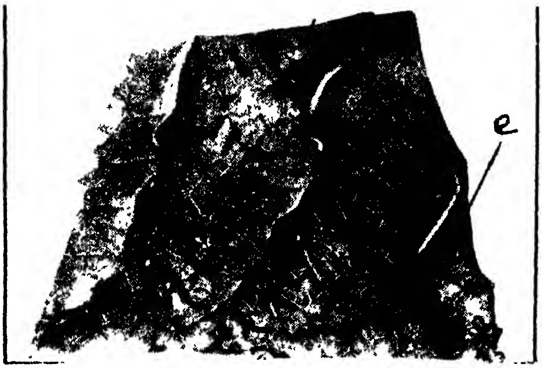


Plate 6 Fig 14 -Vein thickening as seen against the sun.

Plate 6 Fig. 15 -Experimentally transmitted leaf curl on young plant

develop leaf curl. Pl. 6 fig. 13 shows the characteristic appearance of an infected ratoon plant.

Not only is tobacco a host of the leaf curl virus and white-flies, but certain wild plants in various parts of the world are known to be susceptible. It has been demonstrated that the disease can be transmitted to tobacco from a number of plants, among which are the garden Zinnia, sunnhemp, and species of *Vernonia*, many of which occur commonly in the Rhodesian veld, whilst suspected host plants are hollyhock, the garden *Ageratum* and Biloxi soya beans.

Control.—There appears to be little hope at the moment of controlling the whitefly vector of the disease, so that control measures are centred round the elimination of reservoirs of infection.

In Rhodesia very satisfactory control has been obtained by means of legislation whereby all growing tobacco must be uprooted and destroyed by a certain date, allowing a "close season" of about three weeks.

Since the introduction of the Tobacco Pests Suppression Act, 193 ," the only serious leaf curl outbreaks which have occurred have been the direct result of the presence of abandoned tobacco on which whiteflies were breeding.

It would therefore appear that the wild host is not as yet an important factor in Rhodesia in the spread of this disease.

NUTRITIONAL DISEASES.

Tobacco reacts very readily to the deficiency or excess of elements in the soil, and has therefore been used a great deal by investigators of plant nutritional disorders.

Red rust and frenching were described in the Departmental handbook and the latter is again discussed in this section. What was known in Rhodesia as **blackfire** is probably a form of red dust, and as the former disease has recently been identified in America with angular spot, it is now proposed to drop the name locally.

The only nutritional disease new to Rhodesia which has appeared since 1931 is that caused by **chlorine toxicity** in the

soil. The symptoms consist of a curling upwards and inwards of the leaf margins, marked thickening of the leaf blade, accompanied by brittleness of the tissues. Affected leaves usually become very smooth and glossy on the upper surface. Seedlings affected by chlorine toxicity are shown in Pl. 7 fig. 16.

It has been found in America[2] that the disease is most severe on light sandy soils deficient in humus, but contributory conditions in Rhodesia have not been studied.

No control measures have been found to be necessary.

FRENCHING.

Description.—The symptoms of this disease are fully described in the Departmental handbook[1].

Conditions favouring the disease.—The true cause still remains a matter of controversy, although most investigators are agreed that diseased plants may be induced to grow normally if supplied with readily available nitrogen such as is contained in nitrate of soda.

In recent years frenching has been observed on numerous farms in the Colony. In a few instances all the plants in a land have been affected to a greater or lesser degree, but it was generally found that by half way through the season the majority had thrown off the disease and were growing normally. In every case investigated the affected crop had been planted on newly stumped land which was prepared late in the year. Very heavy rain storms had also been experienced in these localities.

Again, frenching of small patches of plants has been observed to occur for two or even three years in succession on the same piece of soil, but such persistence has, fortunately, not been seen over extensive areas. Shear[12] in America records a similar persistence during seasons of heavy rainfall. Moore and Hean[13] in the Union state that soil factors such as poor cultivation, waterlogging and the formation of a hard pan, are associated with the disease. Other workers, including Spencer[14], have found that a similar condition is produced as a result of poisoning by such mineral elements as manga-

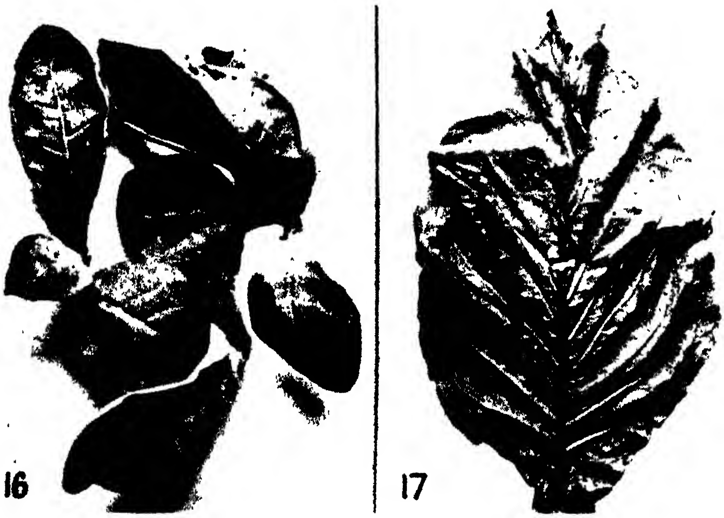


Plate 7 Fig 16 —Symptoms of chlorine toxicity Note curled leaf margins

Plate 7 Fig 17 —Symptoms of lightning damage on a middle leaf The leaf was curled sharply downwards at point where break in the midrib is seen

nese and thallium. No worker has as yet been able to produce typical symptoms at will, so that the cause of frenching must for the present remain a mystery.

Control.—Although no important progress has been made recently in our knowledge of the disease, yet it is fortunate that the measure recommended in 1930([15]), namely, the addition of a top dressing of nitrate of soda at the rate of 45 lbs. per acre whilst the plants are young, is found to give satisfactory control.

In addition, growers should endeavour to avoid the disease by stumping new land sufficiently early in the year to allow the soil to be worked into good condition before planting. Whatever is present or absent in the soil to cause frenching seems, under Rhodesian conditions, to disappear from lands which are well cultivated .

MISCELLANEOUS DISEASES.

Lightning Injury.

Description.—From time to time reports are received of patches of plants some 50 to 100 yards across being killed off or distorted, those nearest to the centre being the most severely affected. The symptoms are twisting and flattening of the stems, especially near the apex, accompanied by curling, twisting and puckering of the leaves. Plants near the centre may be found lying on the ground and in some of them a soft rot of the stalks sets in.

The midribs of many of the leaves develop necrotic areas on the under side, so that the leaf tips curl downwards and inwards towards the stem, simulating in some respects the symptoms of rosette or of "kromnek," as described by Moore([21]). The midrib also appears to be constricted so that the web of the leaf is puckered into folds as shown in Pl. 7 fig. 17. In a short time a soft rot of the midrib commences and frequently extends down the stem in the form of a brown streak. Infection of these damaged areas by soil-inhabiting fungi, particularly species of *Fusarium*, soon takes place and many of the badly injured plants die.

The plants on the margins of affected patches usually show a slight bending of the stems and occasionally bear the rather characteristic kinked leaves.

The trouble was at first suspected to be of virus origin, but numbers of grafts and buds made on healthy plants failed to transmit the disease. The symptoms as they appear in Rhodesia correspond closely with those described by Wolf[22] in America for lightning injury, and local reports indicate that the trouble occurs after heavy thunderstorms. It is reasonable to assume therefore that the affection is caused by lightning.

DISEASES OF CURING.

Barn Rot (*Rhizopus arrhizus* Fischer).

Aerial mycelium grey, light at first, becoming darker; rhizoids present; sporangia numerous, giving black appearance to mycelium, globose; columella hemispheric; spores brown, subglobose 5 to 8 x 4 to 6 microns Zygospores not seen.

Barn rot due to *R. arrhizus* is of common occurrence in closely packed barns and is similar in appearance to the rot which sometimes appears in barns and is found in high conditioned bales. The latter, however, is caused by a closely related fungus, *R. nigricans* Ehrenb.

Description.—The disease begins with a softening of the midribs of the leaves at the butt-end after colouring, and is followed by a furry growth of white or greyish fungus. The butts soon turn dark brown, the discolouration extending downwards into the web of the leaf. The leaf tissues become wet and soggy and the grey mouldy growth of the fungus extends all over the infected area. The disease progresses very rapidly and in extreme cases may cause the hands to break away from the sticks and fall to the floor.

Conditions favouring the disease.—The mould is liable to spread in loosely packed bulks, especially if they are put down in high condition, but the fungus does not appear to be able to develop actively in bales. The presence of barn rot in the latter does, however, affect the saleable value, as a certain mouldy flavour is imparted to the tobacco.

Plate 8 Fig 18 —Barn rot on flue cured leaf (Herbarium specimen)
Plate 8 Fig 19 Stick of flue cured leaf ruined by barn rot.

Barn rot, which is caused by the fungus *Rhizopus arrhizus* Fischer, develops on partly cured leaf maintained in an atmosphere deficient in ventilation and high in humidity. These conditions are brought about by excessively close packing in the barns, which prevents air circulation. Suitable conditions for barn rot do not appear to be caused by high humidity and lack of ventilation alone, such as would result from the addition of too much water and closing of ventilators. Close packing of the tobacco seems to be a necessary factor.

Control.—Prevention obviously depends upon correct packing of barns.

When climatic conditions cause large acreages of tobacco to ripen at one time, the amount of leaf to be cured is often in excess of normal barn accommodation. In an endeavour to obtain as high a yield as possible, it is only natural for the grower to pack as much leaf as possible into the available barn space, but such procedure may have disastrous results if barn rot becomes active.

In order to prevent heavy losses, two alternatives present themselves. Either the leaf must be sorted during reaping and only the best retained for curing, or else priming must be so arranged that the total number of reaped leaves is reduced to suit barn accommodation.

The latter method is obviously preferable, for if priming is carried out at the correct times and the thin, papery leaves from the bottom of the plant are removed, then not only is the remaining crop improved in quality, but frog-eye spotting is also eliminated.

Whenever a difficult planting season makes congestion in the barns inevitable at harvest, growers would be advised to plan their priming operations as far as possible to conform with the situation, bearing in mind that drastic early priming (such as is sometimes necessary for the control of angular spot) may delay ripening by a week or ten days.

Yellow Mould (*Aspergillus flavus* Link).

This disease is not of frequent occurrence in Rhodesia, but may cause appreciable damage during curing under

Wheat Varieties Tested at Salisbury.

By T. K. Sansom, B.Sc., Plant Breeder.

The following selected pure lines of wheats grown at the Plant Breeding Station, Salisbury, are available for free distribution to farmers.

Applicants are requested to apply early, stating what varieties are required.

Not more than six varieties of seed can be supplied to each applicant, and the amount of seed of each variety will depend on the number of applications received for each variety; it is anticipated, however, that not less than 10 lbs. of seed of any one variety will be distributed to each applicant. No applications can be considered which are received after 15th March, 1939.

1. Reward, B.21—22—S—1.
2. Reward, B.23—25—S—1.
3. Pusa, 4.
4. Granadero Klein.
5. Florence.
6. Kenya Governor.
7. Punjab 8A.
8. Renown.
9. B. 256, b.1. A.64 (L).
10. N.B. 230, A.14 (L).
11. 122, D.I.T.L.
12. 131, C.5.P.
13. Pilgrim.
14. Beltista.
15. 58 F.L.I.

16. Sabanero.
17. Beardless non-shattering wheat.
18. Bearded non-shattering wheat.
19. Thatcher.
20. B.286.
21. Lalkasar Wali.
22. Karachi L.3.

The two Reward strains have been grown on a fairly extensive scale during the past few years. They are beardless; of good milling quality; rust-resistant; early maturing, but require a soil in good heart to yield well.

Pusa 4.—Has been grown previously in this country; is beardless; it is susceptible to rust, but in those areas where rust is not bad will yield very well; on the Plant Breeding Station this wheat, under irrigation, has yielded as well as Punjab 8A, which is one of the highest yielding wheats in the country. It is very early maturing and makes little leaf growth, and therefore should be of use to those farmers who thresh by means of hand power.

Granadero Klein.—Is a bearded wheat which is very resistant to rust, and can be recommended for those areas where Karachi becomes badly rusted; it is fairly tall growing and takes approximately the same time to mature as does Karachi.

Florence.—Is a beardless wheat; fairly resistant to rust and early maturing. It has shown promise at the Plant Breeding Station.

Kenya Governor.—Known also as "Somers Koren" and "90 day Wheat," has been grown on a large scale in every district of the Colony for a good many years. It is one of the safest wheats to grow in the Colony, being rust resistant and early maturing, though it seems to be more susceptible to frost than other varieties. A heavier rate of seeding is required for this wheat owing to its poor tillering habit and fairly large size of the grain.

***Punjab** 8A.*—Under favourable conditions this is one of the highest yielding wheats grown in the Colony; but where

rust is severe it should not be grown, being very susceptible. The growth habits are similar in all respects to those of Karachi. The seed, however, grown under the same conditions as Karachi is always a little larger than Karachi seed and has a more metallic appearance.

Renown.—Is a beardless wheat, which is resistant to rust; of good milling quality and fairly hardy.

*B.*256, *b.*1. *A.*64 (*L*).—Is a beardless wheat; resistant to rust and fairly early maturing. This wheat has shown promise at the Plant Breeding Station and elsewhere.

N.B. 230. *A.* 14 (*L*).—Is a beardless wheat; resistant to rust and fairly early maturing. This wheat has shown promise at the Plant Breeding Station and elsewhere. Did well in the variety trials at Umvuma in the winter of 1938.

122. *D.I.T.L.*—Is a beardless wheat; resistant to rust and fairly early maturing. Did well in the variety trials at Umvuma in the winter of 1938.

131.*C.*5.*P.*—Is a bearded wheat; resistant to rust and late maturing.

Pilgrim.—Is a bearded wheat; fairly resistant to rust. Has shown fair promise at the Plant Breeding Station. Shatters more than do most bearded wheats.

Beltista.—Is a bearded wheat, rust resistant and has shown promise at the Plant Breeding Station.

58.*F.L.I.*—Is a beardless wheat; resistant to rust and late maturing.

Sabanero.—Is a bearded wheat; resistant to rust, hardy, late maturing and tall growing.

Beardless non-shattering Wheat.—The glumes of this wheat are stronger than any other wheat, apart from the bearded non-shattering wheat, grown at the Plant Breeding Station.

Bearded non-shattering Wheat.—Same remarks as above, except that this wheat is bearded.

Thatcher.—Is a beardless wheat, resistant to rust, late maturing.

Lalkasar Wali.—Like Punjab 8A, is one of the highest yielding wheats grown in the Colony under favourable conditions. It is perhaps slightly more resistant to rust than Punjab 8A. Vegetative characteristics identical to Karachi.

Karachi L.3.—Is a red seeded selection from Karachi; is bearded, as susceptible to rust as is Karachi and takes the same time to mature. Has a very attractive looking grain.

Applications should be addressed to the Agriculturist, Department of Agriculture, P.O. Box 387, Salisbury.

Cleanliness Aids Insect Control

in Lands and Sheds, Stores and Farmsteads.

Trees and Wild Flowers.

ON THE RHODESIAN FARM.

By CHAS. K. BRAIN, M.A., D.Sc., Director of Agriculture.

PART II.

Two Common Tree-orchids (*Orchidaceae*).—The orchids are among the most beautiful and interesting wild flowers of the country and it is surprising that more attention has not been paid to them. They fall into two main groups, the ground orchids which are classed in the text books as terrestrial and those which live on the bark of trees and do not have roots in the soil, and are therefore called epiphytes.

The family *Orchidaceae* is the largest of the large group of plants with one seedling leaf and leaves with parallel veins as illustrated by the lily family. There are more than five thousand different orchids known, most of which are found in the forests of Asia and South America. There are probably about 60 common orchids in this country, fifty or more of which are ground-orchids. The flowers, throughout the whole family, are unusual. The showy parts are in two sets of three members each. The outer parts may be greenish but are usually white, or pink, mauve, yellow or purple. They are usually referred to as the lateral sepals, *i.e.*, one at each side, and the dorsal or odd sepal. The inner set of three are the petals. They are usually broader than the sepals and the odd one is generally long, often pointed, and is called the lip. The dorsal sepal may be slender or, as in the *Disas*, be shaped like a hood or old-fashioned candle extinguisher. The lip may have side lobes and near the base where it joins the stem it may be produced into a broad sac, or a slender spur which may be many times the length of the whole flower. The remaining parts of the flower, *viz.*, the stamens which bear the pollen and the style which collects the pollen from another flower to fertilise the flower are united into a central column

which faces the lip. In the African species there is usually only one pollen sac or anther which is attached on the top or back of the column. The pollen grains are usually massed into from 2 to 8 club-shaped masses, often with a sticky stalk, which adheres to the head of any bee or other insect which visits the flower for nectar. When the insect visits the next flower of the same kind the pollen masses protrude from the insect's head in exactly the correct position to reach the style and so fertilise the flower. This is a wonderful adaptation to avoid cross pollination.

Angraecum kotschyanum Reichb.—This is an epiphyte which is common on the lichen-covered branches of some of our larger trees. The stem is short with numerous fleshy roots almost $\frac{1}{4}$ inch thick, also usually covered with moss or lichens. The leaves are few in number, up to 4 inches long, thick, fleshy, curved inward with the margins crinkled at intervals so as to appear crenulate. Two or three flowering stems usually arise close together from near the base of the main stem and are usually about as thick as the roots and 8 to 12 inches long. The flowers are about $\frac{3}{4}$ inch across and are creamy white (Fig. 9). They are readily distinguished by the very long straw-coloured spurs which may reach 6 inches in length and are slightly thickened towards the end.

Angraecum Bolusii Rolfe.—This is also an epiphyte which is widespread and common on the thicker branches of our native trees. The stems are long and straggling. The leaves are almost cylindrical with a channel down the upper side, pointed, from 3 to 5 inches long and usually curved. The flowers are small, borne on short thin flowering stems, pale waxy yellow to apricot. The lip is three-lobed, and the spur is $\frac{1}{4}$ to $\frac{1}{2}$ inch long. (Fig. 10.)

The Khaki Weed, *Alternanthera achyrantha* R.Br. Fam. *Amarantaceae.*—This is one of the commonest weeds on roads and footpaths. It seems to flourish wherever subsoil has been exposed. It is a native of South America and the seeds were probably introduced to South Africa in bales of forage during the Anglo-Boer war. The prickly clusters of seed-cases turn khaki colour when ripe and account for the common name given to the plant in South Africa. The khaki weed is a

prostrate creeper and a single plant may cover six square feet, and the growth is so dense that other plants are smothered and die. The seeds are very small, globular, black and shining and are enclosed in the prickly burs which form either singly or in clusters in the axils of the leaves (Fig. 11). Roots are formed at intervals wherever the prostrate stems touch the ground. This weed can only be eradicated by carefully removing all the plants and their rooted branches before the burs mature and the seeds are ripe.

Two Common Amarantus Weeds. Fam. *Amarantaceae.*—Two of our commonest weeds belong to the genus *Amarantus.* They grow wherever weeds occur and often attain a height of two to three feet when growing in rich soil. *Amarantus paniculatus* Linn. is easily recognised by its spiny cylindrical heads. (Fig. 12.) It is probably introduced from Southern Europe. *Amarantus Thunbergii* Moq., a native species, is usually smaller and the prickly seed clusters are small and scattered up the stem in the axils of the leaves. (Fig. 13.) Many of the leaves have a brown or blackish blotch in the centre. A third species occurs in South Africa and is probably present in Southern Rhodesia. It has a pair of sharp spines, about ¼ inch long, at the base of each leaf-stalk, which account for the scientific name *Amarantus spinosus* Linn.

The leaves and young stems of the different species of Amarantus are commonly used by natives as spinach.

These weeds can only be controlled by pulling or hoeing before the seeds mature.

The Thorn Apples or Stink-blaar. *Datura spp.* Fam. *Solanaceae.*—Two species of thorn apple are very common throughout Southern Africa and a third is occasionally found in the lower parts of this country. They are easily recognised by the large leaves, tubular flowers, thorny fruits, and nasty smelling leaves and stems. They are all commonly called stink-blaar (stinking leaf) in South Africa. They belong to the same family as the potato and tomato and contain powerful drugs which make all parts of the plants, including the seeds, poisonous. The air-dried leaves are imported into England from America for the extraction of the drugs atropine, daturine and hyoscyamine, and were formerly added

Fig. 9.—*Angraecum Kotschyanum*, from the Serui, Makwiro, flowering in November.

Fig. 9a.—Flowers showing long spurs.

Fig 12.—*Amarantus paniculatus* Linn

Fig 11.—*Alternanthera achyrantha* R Br Khaki-weed.

Fig 14.—*Datura stramonium* L Thorn apple or "Stinking leaf"

Fig. 13.—*Amarantus Thunbergii* Moq

Fig. 14a —*Datura tatula* Linn.

Fig. 16.—*Petrea zanguebarica* J. Gay, the double thorn.

Fig 15 —*Schkuhria bonariensis* Linn. the dwarf marigold weed.

Fig 18.—*Ceratotheca triloba* E Mey, a common road-side weed

Fig. 17.—*Sesamum capense* Burm

to tobacco for the manufacture of asthma-cure cigarettes. There are cases on record of children having been poisoned by eating the seeds and sucking the nectar from the flowers. In South Africa the seeds are said to be fatal to young ostriches, but farmers in the Karroo and on the Highveld have observed cattle and goats eating the leaves with impunity, but state that when this is done the milk is always tainted. The three species are *Datura stramonium* L., with pale green stems and large white tubular flowers (Fig. 14); *D. tatula* L., similar to *stramonium* but with purplish stems and mauve flowers; and *D. ferox* L. with smaller white flowers and very large curved spines on the seed pod.

The Dwarf Marigold (*Schkuhria bonariensis* L.). Fam. *Compositae*.—This is also an introduction from South America which probably reached South Africa with forage during the Anglo-Boer war. It is an annual weed which varies in height from a few inches up to nearly two feet according to the soil and water. When grown under favourable conditions it produces a roundish bush which is yellowish green in colour, with slender stems and branches and very narrow leaves, which are usually 3 or 5 partite. The flower heads are small solitary, with the bright yellow tubular florets projecting only a little way above the conical case (involucre). (Fig. 15.) It is an extremely common weed in gardens, farmyards and paddocks, and is readily eaten by cattle with the surrounding grass. It is stated to be one of the commonest causes of tainted milk in Southern Rhodesia. A single plant can produce up to four thousand seeds and no attempt at eradication will be successful unless all the plants are removed before the seeds are mature.

The So-called Wild Foxgloves.—Three common weeds, all belonging to the Family *Pedaliaceae* are commonly called wild foxgloves because the flowers look something like the English foxglove, although they are not really closely related to it. *Pretrea zanguebarica* J. Gay, is very common and widespread in pastures. It has long straggling branches which grow prostrate on the ground and which bear large numbers of bright pink flowers with darker markings. The flowers open in succession from the base over a long period and are followed by the large oval disc-like burs with two stout spines which stand upright. These pierce the feet of animals and are

spread over large distances in this way. (Fig. 16.) This plant causes a disease in sheep in South Africa but does not appear to affect cattle. *Sesamum capense* Burm. (Fig, 17) usually grows to a height of from 12 to 24 inches. The characters of the leaves and flowers are well shown in the illustration. The flowers are deep pink to red, often much darker in the throat. The important point to notice in connection with the *Sesamums* is that the long seed pod which grows close to the stem where a leaf stalk joins it has only one beak. This is a native species, but the introduced plant *Sesamum indicum* Linn. is often cultivated in native lands or occurs as an escape from cultivation. This is one of the most important crops in India as the small seeds yields an edible oil which is equal to the finest olive oil. The flowers are either pink or yellow and the seeds vary in colour from almost white or yellow to black. *Ceratotheca triloba* E. Mey. is also a common roadside weed which grows to a height from two to four feet. (Fig. 18.) The stems are hard and woody and the plants persist for several seasons. The flowers are very pale pink with deep-coloured lines on the lip. The seed pod is shorter and broader than in *Sesamum* and has *two* divergent beaks from the top. The three divided lobes to the leaves give the name to this species.

Grass Silage

AN EXPERIMENT AND DIRECTIONS FOR THE PRESERVATION OF GRASS AS SILAGE.

By H. C. Arnold, Manager, Salisbury Experiment Station.

It is proverbial that "distant hills are always green," and it may be assumed that the cattle which graze on those hills are always sleek and maintain their condition without artificial feeding. This we assume because we know that the livestock which graze within our own boundaries do not require any food in addition to the natural pastures when these are eaten in the young stages of their growth.

The natural veld provides an abundance of cheap cattle food, but soon after the grass commences to flower, it becomes tough and fibrous, its flesh-forming constituents diminish in proportion to the total fodder, and its ability to maintain the condition of the animals is much reduced. It is apparent therefore that if it were possible to collect and preserve the surplus veld grass while it is young and tender and before it has dissipated its proteins in its efforts to produce seed, we should then have large quantities of valuable fodder to feed to the farm livestock during that period of the year when the veld takes its rest.

Both scientific investigation, and practical experience, have shown that in order to secure the best yield, combined with high quality, the majority of the various kinds of veld grasses should be cut for curing when their growth is from two to three months old. At this stage they contain nearly as high a proportion of nutrients as grass which is a month younger, but the yield of material is much heavier. The best period for mowing the grass, therefore, lies between the middle of January and the end of February. The weather conditions at that time of the year are not always favourable for making hay, and even when hay can be made there is a risk of much of it being spoiled by late rains, unless it is

stacked under a well built roof, and even then there is a chance of its being destroyed by fire. It would seem, therefore, that, in seasons of excessive rainfall at least, the surplus summer fodder may be conserved in the form of silage more economically and with greater safety, than by other methods. The validity of this statement may be doubted by many of those who made silage in stacks a few years ago, and were not satisfied with the results. One of the main reasons for their failure is shown in the tabulation below, which gives the temperatures recorded at this Station, of grass silage made in a pit, and those of similar material made in a stack. For comparison, the temperatures of a heap of sunnhemp stalks during its reduction to compost are included. The pit used in this trial was a circular hole about 10 feet in diameter and 12 feet deep. Some four to six feet of green grass was deposited in the pit each day as soon as possible after it was mown. On the ninth day the material reached five feet above ground level; it was then "capped" with 1 foot of Canna tops, soil was banked around the sides and over the top. During the next few days the material rapidly settled, and finally came to rest somewhat below the level of the surface of the ground. Cracks which formed in the earthern covering were filled in, and the earth from the side was thrown on to the top, making a covering about three feet in thickness. The stack silage was made over a shallow pit, four feet deep, which was more than filled with green grass during the first day's operations. Layers of green grass about four feet in thickness were added to the stack each day until the tenth day, when it was "capped" with two feet of wet earth. In both the pit and the stack a pipe was placed in the centre to facilitate temperaturing the material, and the thermometer was brought to rest at a point six to eight feet below the top of the heap. While stacking was in progress, if the temperature was found to exceed 140° F., water was applied to lower it. This was temporarily effective, but the practice could not be continued after the stack had been covered with soil. The high temperatures reached after the completion of the stack indicate that the weighting material was insufficient. According to some authorities a pressure of 300 lbs. to 400 lbs. per square foot of the top surface of the stack is required, but as this would mean covering the whole of the stack with

a layer of earth 5 feet in depth, the application of so much weighting material would not be practicable under ordinary conditions.

Temperatures of Grass Silage made under different Methods of Treatment.

No. of days after start of operations.	*Stack Method.* Period of making Jan. 25th to Feb. 3rd. °Farenheit.	*Pit Method.* Period of making Feb. 13th to 21st. °Farenheit.	Compost Stacked July 9th. °Farenheit.
2	95	95	95
3	121	115	130
4	140	125	135
5	144	130	155
6	146	140	161
8	150	142	152
9	ensiling operations completed.		
10	156	130	turned and wetted.
12	160	115	112
14	162	110	155
16	163	110	145
20	163	106	turned and wetted.
25	158	105	109
30	160	104	110
40	156	103	140
60	155	102	133
90	126	100	—
120	120	93	—
150	113	82	—

Comparison of the second and third columns of figures show that during the first nine days, when the material was being collected and ensiled, the temperatures were about the same in both lots. After the pit was closed its temperature rapidly decreased, but those of the stack increased and continued at a high level for four months. The reason for the difference is that air was excluded from the material in the pit, but the sides of the stack were exposed and fermentation continued at a comparatively rapid rate.

Comparison of the second and fourth columns shows that after the first week the temperatures reached by the stack silage were even higher than those recorded for the compost

heap. It is obvious therefore that a stack whose sides are exposed to the atmosphere does not provide an efficient means of preserving this class of vegetable material in suitable condition for use as cattle feed. Even though the material in the middle of the stack may remain sound for a few months, a large proportion of the nutrient material will be destroyed if high temperatures persist for more than a few days.

The stack method of making silage is successfully employed in other countries, and the reason for its proving unsatisfactory here is probably due to the comparatively high temperatures which prevail and the dryness of the atmosphere. The dry air quickly removes the moisture from the exposed silage on the outside and, as successive layers of the material dry and shrink, air penetrates further into the heart of the stack, causing continued fermentation of the silage. Thus the deterioration of the silage proceeds more rapidly under local conditions than it would if the atmosphere were laden with moisture and its mean temperature were lower.

Green grass can be preserved in the form of silage at comparatively small expense if the following elementary rules are observed:—(1) The material must be of a suitable kind. (2) It must be enclosed in a receptacle which can be made reasonably air-tight. (3) Fermentation must be controlled. (4) Preservation must be maintained by adequately weighting the material until it is required for use.

(1) **The Material.**—Although it is not usually possible to make good silage from material which is lacking in palatability and nutrient constituents, some plants which are not palatable to livestock in their green state are readily eaten after they have been converted into silage, *e.g.*, Eriosema or Vaal Bosch, thistles, etc. As a rule only freshly cut material should be used, and that having a moisture content of between 70 per cent. and 80 per cent. is the best. Material that is too dry may be improved by adding the required amount of water at the time it is put into the silo. Material that is excessively succulent should not be ensiled without the addition of some substance, such as molasses, to ensure the right kind of fermentation, and that which is partially decayed should not be used at all, because it results in an evil smelling

product which cannot be used as fodder. The moisture in freshly cut veld grass is sufficient under normal summer weather conditions, but part of this soon escapes if the grass is allowed to remain spread out in the swathe, and for this reason it should be gathered and put into the silo as soon as possible after it is cut. Unless the material is of an exceptionally succulent nature extraneous moisture resulting from rain or dew will do no harm and may, in fact, have a beneficial effect in checking excessive fermentative processes when the work of filling the silo proceeds too slowly.

(2) **The Silo.**—There are many different types of silos, but most farmers in this Colony will find that a hole in the ground, either in the form of a pit or a trench, will be the most economical. The advantages of using a trench instead of a pit are that excavation costs are lower and the material can be dumped inside the silo with a considerable saving of labour. The advantages of using a pit include more compression and better control of temperatures, the material may be chaffed before it is ensiled, filling may proceed more slowly, and cost of applying and removing weighty material is considerably less. Generally, the trench method will be found the most suitable when the silo is intended for temporary use near the place of reaping and when large quantities of easily gathered uncut material is being handled and the work can be done quickly on a fairly large scale. The pit method is the most suitable when the high quality of the material makes chaffing before it is ensiled an economical practice, or when the work must be done slowly owing to the lack of material or equipment. The question of the most suitable size also needs consideration, and this will depend largely on the number of cattle to be fed.

It must always be remembered that as soon as the silo is opened conditions favouring the decay of the material are introduced. In order to avoid loss through deterioration, the dimensions of the silo must not be larger than those which will permit a layer of silage covering the whole of the exposed face to be removed each day and fed, without exceeding the requirements of the livestock. The thickness of the layer of material which it is necessary to remove daily will vary in

inverse ratio to the moisture content and closeness of packing. Hence, if the material is densely packed and contains 80 per cent. of water the removal of a layer $\frac{1}{2}$ inch to 1 inch deep will suffice, but when the moisture content has been reduced to 60 per cent., through much fermentation having taken place during the curing period, or the material being comparatively loosely packed, as is inevitably the case when it is not chaffed before it is ensiled, a layer of three to six inches in thickness will need to be used each day. An average of 30 lbs. may be taken as the daily ration for each head of cattle, and as this is the approximate weight of a cubic foot of uncut grass silage, it will be seen that each two to three square feet of the exposed face of the silage will provide enough food for each animal when a layer of 6 inches to 4 inches in thickness is used daily. Therefore a trench which is 10 feet deep and 15 feet wide and is filled to within two feet of the top will be the approximate maximum size for a herd of fifty head of cattle, because a vertical section six inches in thickness will yield sixty cubic feet of silage minus a small percentage of waste. The length of the trench will depend on the amount of material to be ensiled, and the rate at which it can be cut, gathered and transported with the equipment available. As it is important that the grass should be put into the silo as soon as possible after it is cut and that a layer of at least four feet of material should be put in daily, the silo should be as close as convenient to the place where the grass is cut in order to expedite the work of filling it. Good grass-veld will yield about two tons of silage per acre, and this will occupy about 130 cubic feet of space in the silo, so that a trench measuring approximately 45 ft. x 15 ft. x 10 ft. would be required to hold the herbage from fifty acres of average veld. With the aid of a plough and dam scrapers such a trench can be excavated in a few days. The sides should have an inward slant of about 1 in 6 and an even surface. The slope at the ends should have a gradient which, though fairly steep, will permit the draught animals to pass through.

If a wagon is used the load may be expeditiously dislodged by means of ropes or chains fastened to the back which pass underneath the load, around the front and over the top. Upon arrival at the entrance of the trench these are attached to

another long rope, which is anchored to a suitable object such as a firm post or a tree stump, and the wagon then enters the trench. The length of the anchored rope should be adjusted to that required to ensure that the load will be pulled off at the required spot within the trench. Hay sweeps of the tumble-toby type could be advantageously employed for this work, and it might be found possible to use the Hosier hay sweep in a similar manner if it were practicable to fit broad upturned shields on the points of the shafts to prevent them from entering the material previously placed in the silo. For the measurements and capacity of silos see Bulletin 991 of this Department.

(3) **Controlling the Fermentation.**—Green material is converted into silage and is preserved as such by acid fermentation in the absence of oxygen. The combination of several factors determines the type of fermentation which takes place, but the chief of these are the moisture and sugar content of the material and the amount of oxygen present. The oxygen contained in the air which is imprisoned in the interstices of the material is first used in the fermentative processes, and it is important that this air should be expelled as quickly as possible so as to prevent excessive heating and subsequent oxidation of the material due to the type of bacterial activity which takes place at high temperatures and the reduction of the nutrient value of the silage which results. The best acid-producing bacteria are active at temperatures between 110° and 125° F., and an effort should be made to keep the temperature within these limits by filling the silo as quickly as possible, in order to compress the material and cause the expulsion of both the air and the oxygen which is given off by the living plant cells. Special attention should be given to the compaction of the material where it joins the sides of the silo, by firmly tramping or ramming it, and applying water in liberal quantities if it is readily available.

It is also important that the material should be spread in even layers so that there will be no loosely packed pockets from which it will be impossible to completely expel the air. Although tramping the material in the interior of the silo

does not consolidate it very much, loosely packed places may be detected by this means, and care should be taken to add more material and compact it when such places are found.

Experienced silage-makers can tell by plunging the hand into the material whether the fermentation is proceeding too fast or too slow, but beginners are advised to use a thermometer inserted in a piece of piping which is long enough to reach below the current day's layer of material. If the morning temperature of the previous day's charge is 110° F. to 120° F. a further layer of the same thickness as the previous ones should be added; if the temperature is found to be as high as 130° F., the work should be accelerated so that twice as much material may be put on, and if the temperature rises as high as 140° F. water may be applied at the rate of 1 gallon or more to each square foot of the surface, and as much fresh grass as it is possible to gather should be put on. If the temperature is over 120° F. and operations have to be suspended for a day or two the material should be weighted with logs, stones, bags of soil or any other heavy material which it is convenient to handle. It should be remembered that immature, sappy material heats up much slower than that which is more mature, and during cool and damp weather fermentation is slower and less material will be required than during warm weather. Hence on wet days a layer of material about four feet in thickness may be sufficient, but as much as six feet, or even more, may be found necessary on sunny days, in order to prevent excessive heating.

When the trench is shallow the first two or three days' work will bring the top of the material above ground level, and it will then need to be carefully stacked without overlapping on to the sides of the trench, in order that, as the compression of the lower layers causes that above to sink into the trench, it may do so without catching on the sides. If the temperature is excessive, earth should be banked along the sides of this material to exclude the air. It is advisable to continue stacking the material above ground level in this way for as long as it is convenient to do so, because it will settle down, and after a few weeks the compressed silage will occupy only about one-quarter of the space originally required

by the fresh stuff. If succulent green weeds which are unpalatable to stack are readily available, some economy may be effected by using them for the top layer of one foot or so, because it is practically impossible to prevent that amount of loss through the ingress of moulds among the uppermost layers.

Although for the reasons stated it is advisable to keep the temperature of the silage below 130° F. when for any reason it is found impossible to do this, the farmer need not be unduly perturbed, because even though considerably higher temperatures may be realised the material will provide very useful fodder during the winter months if steps are taken to prevent the continuation of high temperatures after the pit is closed by adequately weighting it.

(4) **Weighting.**—In order to expel the air and the oxygen given off by the living material and also prevent oxidation of the material by the types of bacteria which become active when high temperatures continue, pressure amounting to at least 150 lbs. per square foot must be applied all over the top surface and earth should also be banked against the sides. Any heavy material which can be conveniently handled may be used for creating the necessary pressure; usually the earth excavated from the pit will be the most suitable, particularly as it can be carried on to the heap with dam-scrapers drawn by animals, which will also assist in compressing the silage. A layer of earth exceeding two feet in thickness is required to furnish the necessary pressure. Objects such as large stones, bags of soil, etc., placed at intervals along the sides of the heap provide a convenient means of gauging the depth of soil and of ensuring that an adequate and uniform covering is applied. Cracks which develop in this covering while the silage is settling should be carefully filled. Attention should be given to this at intervals of three to five days, for as long as subsidence continues. Flood water should be prevented from entering the silo, but no harm will be caused by normal rains.

Green grass preserved in the manner described will retain a very large proportion of its nutritive qualities, and be ready for feeding to livestock in from 10 to 12 weeks after the pit is closed, but it may be kept for several years if desired, provided that it is not spoiled in the meantime through flooding and that all cracks which may develop in the weighting material are promptly filled up to prevent the ingress of air to the silage.

Even though when winter comes the hills turn brown, the earth is parched and the grass consumed by fire, the cattle will maintain their condition and the milk continue to flow for the benefit of those farmers whose foresight has directed them to conserve their surplus summer pasturage in the form of succulent silage.

Make Hay if the Sun Shines and Silage if It Rains.

The Rhodesian Home Orchard.

By G. W. MARSHALL, Horticulturist.

(Continued.)

Treatment of Trees on Arrival.—On arrival of the trees from the nursery they should be placed in a shady spot and kept moist until planted. They should not be left for any length of time in the boxes or sacking in which they were packed, but should be heeled into a trench and kept there until wanted. The heeling-in process consists of digging a trench about 18 inches in depth, with one side sloping at an angle of about 45°. The trees are laid in at this angle not more than two deep, the soil being well worked around the roots and the trench then being filled with soil and watered occasionally to keep the trees in good order.

Trees received from a good distance sometimes arrive in a withered condition; these should be completely immersed in fresh water (running water if possible) for at least twelve hours or until the withered stems and branches regain turgidity. The revived trees may then be heeled-in as previously described, or planted if planting preparations have been completed.

Planting.—Before planting is commenced it is well to be sure that all the necessary appliances are at hand. These are: Marking board (previously used when double pegging), spade, sacking to protect the tree roots, secateurs (pruning shears) to trim the tree roots and tops, Bordeaux paste and brush to colour-wash the tree stems, and a sufficient supply of water to water the trees when planted.

Everything being in readiness, a few trees are then taken from the heeling-in trench, the roots being wrapped in damp sacking. Proceed to the first filled-in hole and have a small hole dub between the two pegs, then place the marker board end notches against the two pegs. Take a tree from the damp sacking and cut out the broken, twisted, damaged or diseased

roots, and shorten back those that are too long. All cuts should be made diagonally on the under side of the roots. Care should be exercised that the roots are not at any time during the planting unduly exposed to sun or wind; cool and overcast days are best for planting, but these favourable conditions are not always to be had.

The stem of the tree is now placed in the central notch of the marked board, with the upper roots almost touching the planting board; the soil is then filled in slowly, the roots being evenly spread in all directions and well covered. Now remove the marker board and shake the tree slightly with an up and down action; this will assist the finer soil particles to collect round the roots and fill in the air spaces. A slight mound should be made over the roots at the base of the tree, after which the soil should be firmed by tramping it well over the roots and up to the stem. No fruit tree should be planted too deeply; plant no deeper than it stood in the nursery. This depth will be indicated by the nursery mark (junction of the yellow and brown or green bark of the stem near the roots).

It is an advantage to keep the nursery mark 2 inches to 3 inches above the normal soil level: the tree will then be well planted, and as the soil subsides the tree will gradually sink to the nursery mark level. If the upper roots of the newly-set tree are very close to the soil surface a small mound of loose soil may be placed over them; this will prevent any over-heating or undue drying of the soil surrounding the shallow roots. The mound will gradually disappear with cultivation, but not before the tree is well rooted and no longer requires this additional protection. After planting, cut the tree back as illustrated for deciduous trees. Single stem trees may be headed back to the knee high for deciduous and 30 inches for citrus trees. Nursery shaped trees should have from three to four main arms retained for most deciduous fruits, with the exception of plum trees, which may have as many as six arms retained. The heading back of the tree will enable the reduced root system (lost when lifting in the nursery) to feed the proportionately reduced top in a normal manner.

Many fruit trees are planted without cutting back the tops; this is wrong, and causes an undue demand on the root system, of which over half was left in the nursery at the time of lifting. The larger the tree, the greater the loss of roots at the time of lifting. To counteract the loss of roots a proportional amount of the top must be cut away at planting. The trees should be watered as they are planted with at least eight gallons of water to each tree, and more if the soil is very dry. The watering will settle the soil and at the same time supply the trees with the necessary moisture with which to revive growth. When the surface of the soil is sufficiently dry after watering it may be lightly loosened again to check evaporation.

Protection from Sun-Scald.—It is advisable to protect the stems of all newly-planted trees from the hot sun; some growers use grass, but this is dangerous where ants are prevalent. The best temporary method of protection is to colour-wash the stems with Bordeaux mixture mixed to the consistency of thin cream.

A flat wooden slat of about 3 inches in width is also useful for this purpose; it should be fixed on the western side of the tree stem. The sun's rays are then unable to shine directly on the tender stem and cause sun-scald. Attach the slat to the tree with string or spiral wire, care being exercised that the binder does not damage the bark of the tree by cutting into it. Trees damaged by sun-scald or those with a tendency to sun-scald should be slit through the bark from the ground level to the top of the main stem, also the main arms—always, however, on the western side; this allows the tree to develop naturally, unslit trees are apt to become bark-bound, which dwarfs the trees and affects their productiveness. They are also more susceptible to disease attack.

Where Fruit is Produced on Different Varieties.

Apple and Pear.—On spurs chiefly, also from terminal and lateral buds. Always on wood of the previous season's growth.

Quince. — From co-terminal buds on wood of the current season's growth.

Peach, Nectarine and Almond.—On wood of the previous season's growth.

Apricots and Plums.—Generally on fruit twigs and shoots produced during the previous season's growth.

Figs.—First crop, previous season's wood, second crop, on current season's wood.

Citrus.—On current season's growth; main crop of fruit on spring growth.

Walnut and Pecan Nut.—On current season's growth.

Mango and Loquat.—From terminal buds of previous season's growth.

Most other Tropical and Sub-tropical Fruits.—On wood of the current season's growth.

Grape Vines.—On new season's growth.

Most fruit buds are easily distinguished from leaf or shoot buds by their plumper appearance. With a moderate amount of experience it is possible to forecast the next fruit crop from the current season's fruit—bud formation.

When the bearing habits of the different kinds of fruit trees are understood it is possible for the fruit grower to regulate by pruning the bearing of each individual tree, and thereby overcome to a great extent the necessity for fruit-thinning after the crop has set.

Pruning.—The theory of pruning is based on certain observed facts, and the ultimate objects are:—

(*a*) To produce a tree of a desirable shape.

(*b*) To permit of economical cultural operations.

(*c*) To reduce or stimulate the production of wood or fruit-bearing growth, as the circumstances require.

(*d*) To remove injured, diseased or worn-out growths.

To accomplish these the farmer must take into consideration rules or laws which appear to almost invariably operate in the growth of plants; those of primary importance may be set out as follows:—

(1) The vigour of a tree is dependent upon its leaf surface.

Considering that the leaves are practically the lungs and stomach of the tree, this statement is tantamount to saying that the plant which has the largest transpiring and assimilating capacity must, when food is unlimited, be the strongest grower. This law has an important bearing on all pruning operations whilst the tree is in a state of vegetative activity.

(2) The nearer a shoot approaches a vertical position the stronger will be its growth. This is founded on an unvarying law of nature, by virtue of which the sap of plants flows more freely to the highest point of each shoot.

(3) The nearer a shoot approaches a horizontal position, so does its vigour diminish.

This is only a natural corollary to the previous statement. These two rules have a most important bearing upon the selection of shoots required for wood or fruit production. Vertical shoots usually run to wood above, while those tending towards a horizontal plane turn to fruitage. This goes to show that fruit bearing is an attribute of moderate weakness rather than of great vigour.

(4) The lesser the number of buds upon a branch the stronger will be the growth made by each individual shoot arising therefrom.

This may be put in other words, namely, that heavy pruning of the top tends to increase the production of strong wood growth. Under normal conditions of growth there is a balance between root and top. They mutually nourish each other, but when suddenly the top is reduced, without the inference of disease, the remaining buds make haste to utilise the extra volume of sap sent up to them. Partly for this reason, when pruning newly set trees, the number of buds is reduced by pruning away a large portion of the top shoots.

(5) If the root system be reduced the vigour of the top growth will be correspondingly diminished.

It is this fact which causes orchardists to prune the roots of rank growing unfruitful trees. Again, when young trees are removed from the nursery, many roots are cut off or so

damaged as to necessitate their amputation. To counteract this the top growth must be curtailed, otherwise stunted development or death may result.

(6) When a number of shoots are growing at different levels upon the same tree, generally the topmost shoot absorbs most sap and outgrows those below.

This is seen in every tree, and gives rise to the practice of pinching the growing tips out of the highest shoots on young trees so as to lessen their natural advantage.

(7) Deformations of any kind, such as those produced by wounds or compression of sap vessels, diminish the activity of those parts situated above them.

The correctness of this statement is clearly shown in the effects produced by bruises, large wound scars, partial fractures, or the hardening of the bark caused by sunscald.

(8) Within certain limits, the fruit production of any plant or tree diminishes with the increased development of its vegetative growth.

In other words, when a mature tree is forced into making vigorous growth, its production of fruit is lessened. Again, young trees, when properly nourished and trained, do not fruit freely until they have assumed considerable dimensions and have branches usually growing in a lateral direction, which make weak growth. This also points to the fact that the fruit-bearing habit arises from a quiescent condition in the plant or branch. To quote an extreme case, a superabundant crop of oranges is usually regarded as a sign of the tree having begun to decline.

(9) The smaller the number of fruits the better their quality and size.

This is the chief reason why fruit growers thin their crops at an early stage of development. Pruning also is utilised to the same end. By judicious thining out of the fruiting wood the possible number of fruits is lessened, and each one retained receives a large share of the plant food elaborated.

The Seasons for Pruning.—Winter Pruning.—Winter pruning, which is practised when the wood has ripened and the leaves have fallen from deciduous trees, is most important. When the tree is devoid of foliage, the pruner can see the position of each branch and weigh its present use or calculate its future value.

The general effect of winter pruning is to stimulate vigorous growth when the growing season again begins. Winter pruning may be calculated to ensure wood growth for subsequent fruit crops rather than actual fruit production. It is of the greatest value in shaping young trees or renovating older trees which lack vigour.

The objects of winter pruning may be summarised as follows:—

1. To regulate the shape of young trees.
2. To ensure fruit wood formation on mature trees.
3. To regulate the fruit crop by the judicious cutting out of unnecessary fruiting wood.

Summer Pruning.—Summer pruning is the term used to define those operations which are performed upon a tree while in active growth. The objects are:—

(*a*) To suppress all undesirable growths when they first appear.

(*b*) To admit sufficient air and sunlight to the innermost branches, thus permitting them to mature naturally.

The suppression of all undesirable growths should be performed during the early part of the growing season. Other summer pruning is best performed in the latter half of summer or when there is no danger of the trees making new growth to replace the shoots taken out.

The Desirable Tree.—The ideal shape of a mature deciduous fruit tree is that of a goblet or wine glass, that is to say the tree has a straight, short stem from which arise the main and secondary arms, while the centre is moderately open.

Proper Pruning.—First Year at Planting.—As previously stated, young trees should be headed back at planting time, knee high for unshaped deciduous trees and 30 inches for

citrus trees. When heading back at planting time, it is often found that a good framework has been produced in the nursery. If the branches arise on the main stem at the desired distance from the ground (18 inches deciduous, 30 inches citrus), select from three to six well spaced shoots arising from different points on the main stem and cut out the rest. The shoots retained should then be shortened back to about 9 inches in length or in proportion to their development (6 inches for weak to 12 inches for very strong). Three to four main arms are sufficient for most fruit trees. Plums with advantage may have up to six. The heading back of the main arms should be done in such a manner as to have all the cuts about level; if uneven, the highest one will outgrow the rest and produce a one-sided tree. When viewing a recently headed back tree from above, the cut surfaces of the three-armed tree should form a triangle, if four a square, and if six a hexagon.

Summer Treatment.—The first growth that takes place after planting, if correctly treated, will soon form a well-shaped tree. Two shoots should not be allowed to develop from one spot. The weaker shoot should be rubbed off when still young and tender. If double shoots are allowed to develop from one spot on the main stem or main arms of a tree, they will form a Y crotch, which is objectionable owing to the likelihood of the crotch splitting with the weight of the fruit when the tree commences to bear.

All those shoots that have a tendency to cross or crowd each other should be suppressed. The energy required to produce these unnecessary shoots will then be deviated to the desired ones, which in turn will grow more vigorously. Shoots having a tendency to outgrow the rest should have their tips pinched back; this check generally has the desired effect of balancing the new growth. If the heads of the young trees are inclined to become too dense, it is advisable to thin out some of the growth. Air and light are essential for good healthy development. All shoots arising on the main stem should also be rubbed off as they appear; neglect in this respect will result in multi-stemmed and mis-shaped trees.

In training during the growing season the aim should be to encourage at least two good shoots to develop from each

main arm, one from either side. Trees with three main arms will then have six secondary arms, those with four will have eight, and so on.

Second Year's Winter Treatment.—If the trees have been well shaped during their first year's growth there is very little to be done during the second year's winter pruning when the leaves have fallen. All that is necessary is to cut any badly shaped, diseased or crowded shoots that may have been overlooked during the previous summer treatment. In trees with a natural spreading habit (apricot), the erect growing shoots should be retained for the secondary arms or leaders (see fig. 5, parts of a tree, for explanation of these terms). With erect growing trees (Wickson plum), retain shoots to form the leaders from those with an outward growing tendency. Adopt long pruning for best results; this means the non-cutting or shortening back of the retained fruiting or other wood. All shoots that are removed should be cut off close up to the limbs that form the framework of the tree; stubs are objectionable, as they may either produce an abundance of unnecessary growth or die back and so impair the health of the tree.

In all pruning operations care should be exercised not to injure the tree unnecessarily. Use good and sharp pruning tools, and see that all cuts exceeding ½ inch in diameter are coated with a suitable oil paint: this prevents water from entering the wound, also decay.

Second Year's Summer Treatment.—This is similar to the summer treatment previously mentioned, comprising rubbing off all undesirable double growths, suckers and shoots that have a tendency to cross or crowd each other.

Early maturing varieties such as plums may have their strong lateral shoots broken back, but not detached, to about one-half their length. This breaking back should be done about January or sufficiently early in the growing season to enable the lower half of the treated shoot to form fruit-producing wood. This treatment, too, is recommended for large trees in vigorous growth. In many cases apple trees, if left to themselves, will have a tendency to produce one or more long shoots. When this occurs these shoots should be pinched back when about 9 inches in length to induce branching.

Third and Subsequent Year's Treatment.—From now on the aim is to prune for fruit. If long pruning is adopted, summer pruning will be found to be of the greatest importance, as it will enable the grower to suppress at the correct time all unnecessary growths, and by the breaking of strong laterals induce good fruiting wood to form where it is wanted.

The winter treatment should then be confined to the cutting off of the broken points of the summer treated laterals, fruiting wood where crowded should be thinned, and leading shoots that grow too high should be shortened. When heading back a tall tree, select an outward growing lateral that arises some distance below the tip of the leader (see fig. 6), and cut off just above the one selected. This system of heading back tall growing trees eliminates the possibility of a dense top growth occurring, as would be the case if other heading back methods were practised.

In a tropical climate and with the sun directly overhead in summer, it is not advisable to have the trees too open in the centre. To serve as a reasonable protection from sunburn, a few small branches should be left to develop from the secondary arms: these should grow inwardly, but should not be too dense. When deciduous fruit trees are left unpruned they have a tendency to bear heavy crops of small fruit every alternate season and little or no fruit in between. This is due to the trees being weakened through lack of proper care and nourishment, and they are consequently unable to mature a crop of fruit and fruiting wood for the succeeding year, as is done in healthy and well pruned trees.

Root Pruning.—Large fruit trees that bear no fruit but grow profusely should be root pruned; this will reduce the tree's vegetative activity and induce fruitfulness.

Root pruning is done by digging a trench round the tree, usually equal to the spread of the branches and about 2 to 3 feet deep. All roots that cross the trench are cut off, and the trench should then be refilled with the soil previously taken out. This treatment is generally effective, but this class of unfruitfulness must not be confused with that due to lack of inter-pollination.

Unprofitable Trees.—Many fruit trees on reaching maturity may be found to be unprofitable; the trees may either produce inferior fruit or poor crops. They should be rooted out or re-grafted to suitable varieties.

Some fruit trees, if old, seldom give satisfactory results when top-worked, and should be replaced with young trees. Apple and pear trees may be top grafted to some known good variety.

Trees Fruiting too Young.—Early fruiting should not be encouraged on young trees, as it is apt to dwarf or affect them to such an extent that they may be of little or no value in later years. It should be the aim of every owner to encourage top growth, and to achieve this all fruit must be stripped from the trees as it sets, thereby enabling them to utilise all of their energy for the development of the frame and fruiting wood of the tree.

No hard and fast rule may be laid down for the age at which trees should bear their first crop of fruit; this is dependent on many factors, but for the guidance of those unaccustomed to working with fruit trees it may be as well to give the average bearing age of a few of the more important fruits. These are:—

Citrus Fruits.—These often set a small crop of fruit within a year of planting, but they should not be permitted to bear before the third season, and in some cases, when the tree has made a poor growth, not before the fifth season.

Stone Fruits (Peach, Plum, Apricot, Almond, Nectarine, etc.).—If the trees make good growth during the first season they may be permitted to carry a little fruit during the second year. The third year, however, is the correct time for them to commence fruiting.

Pomaceous Fruit (Pear, Apple, Quince, etc.)—A very wide range of bearing ages is to be found in this group. Some varieties may commence bearing the second or third year after planting: others not for ten or more years. A fair average may then be taken at five years, but on no account should any trees in this group be permitted to bear before the third season, and then only one or two specimen fruits per tree.

Other Fruits.—Guava and paw-paw, second year; fig, mulberry, custard apple and mango, third year; avacado pear (seedling), seventh to tenth year, budded third to fifth year.

Fruit Thinning.—Many fruit trees, although well pruned and cared for, may have a tendency to produce more fruit than they are capable of maturing, the resultant crop often being very small and unsuitable for the home requirements.

All trees should be examined a few weeks after blossoming, and those that set too heavy a crop should have the fruit thinned out to enable the tree to safely carry the load and at the same time produce good sized fruit.

By thinning a fruit crop it is often found that it is possible to produce an equal weight of good large fruit from a tree that has been correctly thinned as would have been the case had the whole crop of fruit been retained. To obtain the best results fruit thinning should be carried out when the fruit is still small, as late thinning is unsatisfactory. Every owner must use his own discretion when thinning fruit, as he will be the only one capable of gauging the fruit-carrying capabilities of his trees.

To assist those undertaking this operation for the first time it may be advisable to lay down a few rules to be observed when thinning, namely:—

(*a*) When fruit is borne in clusters it is advisable in most cases to reduce the clusters to three fruits.

(*b*) Fruits borne along the entire length of lateral shoots: these should be thinned down to one to four fruits, or in accordance with the vigour or length of the shoot.

Harvesting and Storing.—All fruit should be carefully gathered and placed in padded baskets or boxes. It should be handled much in the same way as eggs, for all bruised fruit will have its keeping quality impaired. A ladder should be used when necessary; do not pull the branches down, they may be broken, and if this happens the shape of the tree may be ruined. Many years' work is necessary to re-shape broken trees.

Some fruits ripen better when stored in the house or store. These varieties if left to ripen on the tree produce fruit of an inferior quality, mealy and unpalatable. Wickson plums and most apples and pears must be gathered before ripe if the best flavoured fruit is wanted. When harvesting pomaceous fruits such as pears, apples, etc., it is extremely important that the fruit be neither too green nor too ripe, but there are a few exceptions to this rule. An excellent test, although not always dependable, to ascertain the correct stage for harvesting the pear in particular is one in which the fully developed fruit is gently lifted upward. If the fruit stalk detaches from the twig or shoot easily, the fruit is ready to harvest. A safer test for the amateur is one where the fruit is cut through the centre horizontally to expose the seed cavities. If the seed is commencing to turn brown the fruit is fit to harvest. But some apple and pear varieties may be found to have brown seeds before the fruit is quite fit to harvest, and here a little experience in picking is necessary.

When harvesting fruit the picker must always aim at the retention of the stem or stalk. Fruit from which the stalk has become detached will decay or wilt more readily, and the keeping properties are considerably impaired. Fruit that does not detach easily must be clipped in the same manner as is done when harvesting citrus fruits.

Harvesting should continue from time to time as the fruit sizes up and is at the correct stage of ripeness. It may sometimes be necessary to pick over a tree several times. Harvesting should take place when possible during the cool period of the day. If carefully handled at harvesting, many varieties of fruits may be stored for several weeks. The fruit may be spread out on shelves or packed in single layers in clean boxes. These may then be stacked one on the other. When storage is contemplated it is as well first to test the keeping qualities as the different varieties ripen, and to do this it is advisable to pick a little fruit at different stages of ripeness. This will soon furnish the desired information regarding keeping quality and the best stage of ripeness at which to harvest. Immature fruit will generally shrivel and over-ripe fruit become mealy. The correct stage will give good coloured and well flavoured fruit.

Irrigation.—If water is available, trees should never be allowed to suffer for want of it. All trees require water in early spring before blossoming, and citrus trees again when in full blossom.

Irrigate whenever the soil lacks moisture or when the tree leaves are inclined to feel limp (not turgid) when felt in the early morning.

The absence of sufficient moisture soon affects the turgidity of the leaf and is easily detected about breakfast time. If trees have sufficient moisture the leaves will be crisp. Too much water is just as harmful as too little; trees so treated are more susceptible to disease, fruit is inferior in quality and lacks keeping qualities. Never allow water to come in direct contact with the stems of trees nor apply cold water to fruit trees such as the fig when the soil is hot. This may cause shedding of the immature fruit.

Small and frequent applications of water should not be given; this induces shallow rooting, while most of the added moisture is lost by evaporation. Rather supply water in much larger quantities and at intervals of one month to six weeks, and loosening the surface soil after the water has soaked away.

Manuring.—All fruit trees should be manured and fertilised from the time they start bearing fruit. Farmyard or kraal manure is the best, for it not only supplies necessary plant foods, but a large amount of humus. This organic matter improves the physical condition of the soil, and is in every way desirable. Necessary soil bacteria are able to increase and liberate other plant foods. If manure is unavailable, green crops must be planted, and these, when grown, should be ploughed or dug in. Leguminous crops, such as beans, peas, sunnhemp, etc., are best; they absorb nitrogen from the air and fix it in the soil through the agency of bacteria present on their roots.

All weeds that are cut out from time to time should be saved, and at the end of the rainy season spread out and ploughed in along with the green crop. In addition to green cropping, artificial fertilisers are sometimes advisable, the quantity to apply varying with the nature and fertility of the

soil. There is also the age or variety of tree to consider. Complete fertilisers are as a rule the best, for they contain all the essential plant foods. As a basis to work on, well grown fruit trees should receive 100 lbs. of kraal manure per tree per annum; also a complete commercial fertiliser containing 16 per cent. phosphoric oxide, 6 per cent. nitrogen and 15 per cent. potash. This commercial fertiliser, known as fruit and citrus fertiliser, may be applied at the rate of 1 lb. for each year of tree's age, with a maximum of about 10 lbs. for deciduous and 15 lbs. for full grown citrus and other evergreen fruit trees.

The most convenient time to apply the manure and fertiliser is at the end of the rainy season or when the soil is in good condition for ploughing it in. All manures and fertilisers should be broadcast between the trees (not under them). This applies to well grown trees which have their root systems well distributed throughout the soil. For young trees the applications may be made nearer the trees, but not nearer than one foot from their stems.

Cultivation.—All work connected with fruit growing must be carried out systematically, and a definite programme should be laid down and rigidly adhered to. Every detail of working is an important item and must be attended to at the correct season. There is a right time for all orchard work, and if this opportunity is once missed it is liable to be reflected in the next season's crop, and even for longer periods.

It is, unfortunately, a not infrequent occurrence for the orchardist to defer working up the land immediately after the rains have ceased. Thus when the delayed work is eventually carried out a good tilth is not obtained. Incalculable harm may be done to fruit trees by delaying the autumn digging or ploughing until so late that the ground has become too dry for effective tillage, and much of the soil moisture has been lost. On the heavier soils, too, the earth breaks up into huge clods, and it may then take more than a whole season to bring back a good tilth to the orchard.

Instances could be quoted where such delays have occurred in cultural operations, with the result that the crops of fruit then maturing were impaired, and the crops set a few

months later were greatly reduced. Delay in carrying out the necessary cultural operations usually spells loss of crop, and these remarks apply not only to cultivation, but to all other phases of orchard work.

Cultivation is beneficial and necessary in many ways to the general health of an orchard. It pulverises the earth and allows aeration of the soil, and the water retaining capacity of the land is increased. Rain more readily penetrates to the deepest layers, and evaporation is checked by the reasonably fine top mulch produced by good tillage.

In Rhodesia we must always be prepared for a possible shortage of rain, quite apart from the certainty of a period of six or even seven months when no appreciable rainfall can be expected, and our system of cultivation must be adapted accordingly.

Before the wet season arrives the orchard should be thoroughly cultivated so as to be in a condition to receive the greatest possible benefit from the rains that may fall. When the cultivation is completed, and after the first good rains have fallen, it is advisable to sow a cover crop of sunn-hemp or some kind of bush bean over the whole area between the trees. When the cover crop has attained its maximum growth, and if the rainy season is drawing to a close, or if the orchard soil is not too wet to plough, the crop should be turned under by ploughing first in one direction between the rows with a mouldboard plough to a depth of from five to six inches, and then when the turned under cover crop is sufficiently decomposed and it is not likely to be dragged out of the soil again, the grove should be cross-ploughed, this time to a depth of about eight inches. By setting the plough at the greater depth when cross-ploughing no vegetable matter will be left on the surface of the soil.

When the ploughing and cross-ploughing have been thoroughly done, the soil should be well harrowed in both directions.

The unploughed soil under the trees should also be dug over at this season of the year, when all the weed growth and

fallen leaves will be turned under. An ordinary digging spade is best for this work, as the hoe or fork is more likely to damage roots.

When the entire orchard has been worked by ploughing and digging it should secure fairly frequent cultivation, the period between these cultivations not usually exceeding one month. Cultivation is also necessary when the soil is sufficiently dry after each irrigation.

Inter-cropping.—Under some circumstances young orchards may be successfully inter-cropped, but this should not be attempted unless proper cultivation can be given and manure can be liberally applied. Inter-cropping enables the man with limited capital to overcome the initial expense of cultivation and incidentally leads to regular cultivation between the trees. Tall growing plants such as maize should be avoided, and the inter-crops should be restricted to such as peas, beans, tomatoes, potatoes, etc., whichever suit the conditions best and are likely to be the most profitable.

Where no irrigation is practised inter-planting should only be confined to the rainy season, and then only to such crops as will mature before the approach of the dry season.

Diseases.—When considering the question of diseases, adopt the principle that prevention is preferable to attempted cure; most diseases are preventable, few curable. Many home orchards are neglected from the time disease and pests first make their appearance. This would not be the case if growers when establishing their orchards would look upon spraying as one of the essential cultural operations. Many trees planted by the pioneers did well for a time, but when disease made its appearance they were abandoned.

To maintain fruit trees in good and healthy condition, make a practice of spraying annually with a fungicide. Spray in winter before the trees start growth. A good spray for this season of the year is lime sulphur mixed according to the directions on the container. Proprietary lime-sulphur is recommended; home-made solutions take time and are so often incorrectly made. This winter spray acts as a tonic to the tree: it is also an insecticide as well as a fungicide. Bordeaux mixture is also a good spray for winter or summer use. It is

fungicide purely and simply. Use the formula 4.4.50, that is 4 lbs. bluestone ($CuSO_4$), 4 lbs. quicklime (CaO) and 50 gallons of water. For tender plants use half strength—4.4.100. This spray may be used for any disease control. The novice is recommended to use the proprietary prepared Bordeaux. It is usually bought in small quantities from stores stocking horticultural supplies.

In preparing home-made Bordeaux mixture, quicklime of good quality is best. If this calcium oxide content is low more lime must be used.

Stock Solution.—Dissolve 4 lbs. bluestone ($CuSO_4$) in 4 gallons of water. Use a wooden or earthenware vessel. Metal containers must not be used, for they will corrode and the spray may be spoiled. Next take 4 lbs. quicklime and slake. This is done by adding water gradually to the lime until the burnt lime breaks down and forms a powder. When water is added to the lime a chemical change takes place: heat is generated during the process, and if water is added in moderation the slaked lime will become a fine white powder. This slaked lime is next added to 4 gallons of water and stirred well. We now have two stock solutions containing 1 lb. of lime or bluestone to the gallon of water. To make up the mixture on a small scale procure a wooden barrel and add 10½ gallons of water; next take 1 gallon each of the stock solutions and pour simultaneously into the barrel containing water. If free bluestone ($CuSO_4$) is in the mixture it is dangerous to apply it to trees in foliage.

Test.—Dip the blade of a clean knife into the mixture after well mixing it, and after a minute's immersion if the blade shows a copper coating more lime water must be added to neutralise the excessive bluestone ($CuSO_4$).

Agitate the mixture when spraying. Stock solutions will keep for a considerable time if covered and protected from the air.

Hardy deciduous trees may be sprayed in winter with a solution of 1 lb. bluestone to 25 gallons of water. This is very effective in preventing disease and lichen growth. *It must not be used on foliage or tender plants, for they will be killed.*

Insect Pests.—A knowledge of the feeding habits of insects is essential if pests are to be controlled and good sound fruit grown. A simple classification is as under:—

1. Chewing insects.

2. Sucking insects.

When spraying to combat the ravages of chewing insects a poison mixture must be used that will not damage the fruit or foliage. The best spray is arsenate of lead, 1½ lbs. to 50 gallons of water. The spray must be well atomised so that a fine film of poison is left on fruit and foliage when the trees dry after being sprayed. Chewing insects attacking the sprayed trees are poisoned before they do damage. It is sometimes necessary to spray several times, especially when insect pests produce more than one generation during the season. All fruit and foliage chewing insects may be controlled with this spray.

Sucking insects are divided into two different classes:—

(*a*) Those sucking food from the surface of fruit or foliage.

(*b*) Those sucking food from inner tissues of fruit or foliage.

Surface sucking insects (fruit fly, house fly) are best controlled by baiting attacked plants with a sweetened poison. This must be sprayed on to the foliage of the treated plants or trees in small drops. Use the ordinary garden syringe for applying, keep the mixture off the fruit as much as possible. Try to get bait in the shady part of the trees where the fly rests during the day. This treatment will kill most of the mother flies before they lay eggs. Treatment is started about three weeks before fruit ripens, and is continued to the end of the season; in dry weather about every ten days, in wet weather when foliage is dry after each rain. The mixture is poisonous to human beings and animals, and must be kept under lock and key. It is made up as under:—

2 ozs. arsenate of lead, powder.

⅓ gallon treacle, or 2½ lbs. cheap sugar.

4 gallons water.

Dissolve sweetening matter in a little water, mix arsenate of lead, then add full quantity of water. Keep agitated while spraying.

Insects sucking their food from the inner tissues, such as scale of all varieties, must be sprayed or fumigated. The latter method is most effective, but not always possible owing to the cost of necessary equipment. The object in view when treating this class of insect is to burn or suffocate it. Resin wash is one of the best sprays for this work. If the trees are well and evenly sprayed the insects will have a complete film form over them. This when dry will exclude air from their breathing pores and they then die and fall off. Resin wash may be purchased from most firms stocking horticultural appliances, or it may be made up as follows:—

24 lbs. cheap resin (or 2½ lbs).

5 lbs. caustic soda (or ½ lb.);

2½ pints fish or cotton seed oil (or ¼ pint);

100 gallons water (or 10 gallons).

Heat 15 gallons water to about 150 deg. F., then add the caustic soda slowly and next the oil. When the mixture starts boiling add the resin gradually; keep adding water to prevent boiling over, and boil for about half an hour after all resin has been added. The mixture should have no lumps or resin in it, and the colour should be that of very strong tea. The added water should bring the quantity of concentrated spray up to 25 gallons: dilute to 100 gallons or 1 to 3 of water, and to obtain the best results spray when warm (not hot). Resin should be well powdered before adding to the boiling mixture.

Pests affecting the roots of plants are more difficult to control. These include nematodes, worms, woolly aphis on apple roots, etc. Soil fumigants are best for treating this class of pest; tobacco dust is good if worked into the soil round the trees. Vaporite is also used for this purpose: the latter is usually stocked by wholesale chemists.

General precautions must be taken against pests and diseases. Collect all visibly affected fruits and destroy them.

Never leave fallen fruit on the ground for any length of time. Boil or bury them very deeply. Such measures have a marked and beneficial influence on the control of all pests. Hand collecting of some of the insect pests is necessary if they are to be checked or destroyed.

SUMMARY.

1. The best orchard soil is a light to medium light loam with good depth and drainage.

2. All orchards should be sheltered either naturally or artificially from the hot and dry winds experienced during the Rhodesian spring.

3. The best aspect for the orchard is a gentle southern and eastern slope.

4. Preference should be given to a site capable of being irrigated.

5. The site should be near the homestead.

6. The land should be well prepared and graded before planting.

7. All holes should be dug 2 feet square and 2 feet deep, then be filled with good surface soil.

8. Trees should be planted at the correct spacing, if necessary so arranged that short-lived trees may at a later date be taken out to furnish more growing room for longer lived larger trees.

9. Trees should be ordered well in advance of the planting season; this ensures securing the desired varieties.

10. Deciduous trees must be planted in June and July; citrus and evergreen trees generally early in the rainy season.

11. Buy first size healthy trees from an established nurseryman.

12. Choose varieties suitable for the zone you wish to plant them in. Cherries will not grow at Mazoe, nor will paw-paws grow at Inyanga Hotel.

13. If trees are dry and shrivelled on receipt, treat them as directed.

14. Plant trees no deeper than they stood in the nursery; deep planting is fatal to most trees.

15. Certain varieties must be planted side by side for inter-pollination purposes. Bordeaux wash, or affix wooden slats on the western side of the stems of young trees; this prevents sun-scald.

16. Pruning is essential with most deciduous fruit trees. In order to regulate the crops the owner must understand the fruit-bearing habits of the trees to be pruned. Vigorous trees require light pruning and weak trees heavy pruning.

17. Winter pruning should be performed when the trees have shed their leaves. Summer pruning is done during the growing season.

18. All deciduous trees should be shaped like a goblet or wine glass. This allows air and light to penetrate to the inner branches. In Rhodesia the trees must not, however, be kept too open in the centre.

19. All dead, weak and diseased wood must be cut out; also branches that cross or crowd each other.

20. All unprofitable trees should be replaced with good varieties either by re-planting or top-working.

21. It is a mistake to allow trees to fruit too young; this causes dwarfing, and they are of little value in later years.

22. The fruit should be thinned out of all trees that have a tendency to over-produce; 100 good large fruits are better than 500 small ones.

23. Fruit thinning must be done soon after the fruit has set; late thinning is useless.

24. When harvesting fruit, handle it as you would eggs.

25. Use a ladder on large trees; other methods end in broken limbs of trees or pickers.

26. Over-ripe fruit is often unpalatable; harvest all fruit at the correct stage of ripeness. Many late apples, pears and other fruits may be stored for several weeks.

27. All trees should be watered when they are in need of it; fruit crops will fail if the soil is dry when the trees are in bloom. When possible, irrigate all fruit trees before they blossom, and citrus trees again when in full flower.

28. Fruit trees are incapable of producing annual crops of good fruit without being fed. They should be fertilised and matured from the time they commence to bear. Large trees require more feeding than small ones.

29. Early autumn is a good time to feed trees, as the food may then be ploughed under with a green crop.

30. Sunnhemp is the best green crop to grow between the trees, for ploughing it under furnishes a large amount of humus-forming material, which is particularly valuable if farmyard manure is not available.

31. Good cultivation is essential for successful growing. Plough the ground in autumn, loosen the soil under the trees and harrow occasionally to produce a good tilth and conserve the soil moisture.

32. Cultivation enables the roots to receive sufficient air, which is so necessary for their healthy development.

33. Inter-planting of young orchards may be practised. Tall growing crops are unsuitable, since they exclude air and light from the young trees. Do not inter-plant large trees; they require all the air, space and plant food available.

34. Spray in winter with lime sulphur; this prevents disease and destroys pests.

35. Leaf and fruit chewing insects may be killed by spraying their food supplies with poison.

36. Sucking insects are destroyed by poison baits or a caustic contact spray.

37. Most spray mixtures are poisonous things. They should be kept under lock and key, and be handled with great care.

38. The Government Horticulturist is employed by the State to give advice on fruit culture. Make use of him.

Rhodesia Weather Bureau.

DECEMBER, 1938.

Pressure.—Barometric pressure was below normal in all parts of the Colony.

Temperature.—Maximum temperatures were mostly 2° F. to 3° F. below normal, while minimum temperatures were a little above normal. The means varied from normal to 1.5° F. below.

Rainfall.—The rainy season only commenced in earnest on the last day of November, but December, particularly the latter half, proved to be a wet month in practically all districts. Many stations had record rains for December. Twenty stations recorded over 20 inches for the month. A large number of these were in the Salisbury and Mazoe districts, and several were in the Eastern Border mountains. The month was also remarkable for the large number of heavy falls. Forty-five stations, in various parts of the country, reported falls of over 4 inches in one day.

Air Masses.—The Equatorial low extended into Southern Rhodesia frequently during the month. This led to a steady inflow of air from northerly directions. Maritime air entered the south on several occasions, but affected the north of the country very little. Towards the end of the month the Equatorial low moved bodily southwards into the Union, and a strong westerly current developed over Rhodesia.

PRECIPITATION.

Station.	Inches.	Normal.	No. of Days.
Beitbridge	3.81	2.27	12
Bindura...	17.32	7.05	23
Bulawayo	8.25	5.07	21
Chipinga	13.85	7.92	21

Station.	Inches.	Normal.	No. of Days
Enkeldoorn	15.39	6.58	19
Fort Victoria...	11.27	5.51	16
Gwaai Siding...	9.61	5.23	22
Gwanda...	4.45	4.24	16
Gwelo...	11.21	5.88	24
Hartley	15.20	6.68	23
Inyanga...	12.49	7.49	25
Marandellas	16.17	7.31	28
Miami	12.92	7.13	24
Mount Darwin	12.13	6.51	24
Mount Nuza	22.01	15.55	29
Mtoko	10.32	6.81	25
New Year's Gift...	5.90	5.33	19
Nuanetsi	6.94	2.90	13
Plumtree	8.59	5.46	20
Que Que	16.62	6.17	24
Rusape.	11.91	7.04	20
Salisbury	9.59	5.91	21
Shabani	7.41	4.65	20
Sinoia	15.04	6.79	24
Sipolilo	9.21	7.11	23
Stapleford	25.37	12.32	28
Umtali	9.66	5.46	25
Victoria Falls...	11.22	6.01	20
Wankie	7.56	5.49	18
Abercorn	6.19	—	14
Balovale	13.98	—	27
Broken Hill	8.22	—	23
Fort Jameson	9.87	—	19
Fort Rosebery	9.40	—	13
Isoka	7.71	—	15
Kalomo	11.52	—	18
Kanchindu...	7.05	—	17
Kapiri M'poshi	4.20	—	16
Kasama...	8.35	—	26
Kasempa	11.07	—	20
Livingstone	10.52	—	22
Lusaka	6.71	—	22
Mankoya	4.30	—	9

Station.	Inches.	Normal.	No. of Days.
Mazabuka...	8.54	—	19
Mkushi	9.00	—	22
Mongu	6.25	—	18
Mpika	6.45	—	18
Mporokoso...	6.11	—	18
Mufulira	8.35	—	24
Mumbwa	9.97	—	20
Mwinilunga	13.23	—	28
Ndola	8.63	—	21
Petauke	7.70	—	20
Senanga	11.89	—	22
Sesheke...	10.23	—	19
Shiwa Ngandu	7.44	—	15
Solwezi...	10.74	—	21

DECEMBER, 1938

Station	Altitude (Feet)	Temperature in Stevenson Screen at 4 feet °F — 8-30 a.m. Dry Bulb	Wet Bulb	Dew Point	Vapour Press Deficit	Maximum	Minimum	Max + Min ÷ 2	Absolute Maximum	Date	Minimum	Date	Number of Days Max > 85°	Max < 70°	Min > 65°	Min < 40°	Mean of 24 hours	Pressure Millibars 8-30 a.m. Station Level	8-30 a.m. 1200 gdm.	Mean of 24 hours	Cloud Tenths	Sunshine Hours
Beitbridge...	1,486	77 1	69 1	65	10 6	88 0	69 8	78 9	102	19	60	9	19	..	29	.	77.8	960.9	879 8	959 5	7 0	...
Bindura...	3,700	69 4	65 4	63	4 8	79 2	63 7	71 5	84	2	61	1		...	4	...	70 1	...	...	..	7 8	...
Bulawayo	4,393	67 3	62.9	60	5 0	77.1	60 8	69 0	85	13	52	9		2	..	.	67 8	867 2	878 7	865 8	8 1	4 7
Chipinga	3,685	69.1	65 0	63	4 8	76 5	62 0	69 3	86	12	56	8	1	3	4	...	68 1	890 2	879 7	.	8.2	...
Enkeldoorn	4,808	66 4	62 5	60	4 4	76 2	59 8	68 0	86	12	54	8	1	3	...	...	65 7	855.3	879 4		7 2	..
Fort Victoria... ...	3,571	70 2	64 9	62	6 3	80 0	62.9	71 5	90	19	57	9	4	3	8	.	69 8	892 9	878 8	891.9	6 7	..
Gwaai Siding... ...	3,278	70.6	66 1	63	5 6	84 3	63 6	73 9	94	19	56	9	10		9	...		901 7	879 4	..	6 9	..
Gwanda...	3,233	71 3	65 3	62	7 2	81 3	64 6	72 9	93	19	55	9	9	1	13	..	71 3	903.6	878.2	...	7 1	.
Gwelo	4,629	66 3	62 8	61	4 0	76 0	60 1	68 0	84	12	53	9		4		...	65 8	863.0	881 8	..	8 8	...
Hartley...	3,879	69 1	64 8	62	5.3	78 4	62 8	70 6	83	12	57	9	.	...	...		69 3	883 2	878 8	...	7.4	..
Inyanga...	5,503	66 2	61 6	59	5 1	72 3	57 6	65 0	78	12	50	10	..	6	...	..	63 7	.		.	7 5	..
Marandellas	5,453	64 5	61 0	59	3 8	72 0	58 5	65 2	79	20	53	8	.	5	..	...	63 6	.	...	..	7 8	..
Miami	4,090	67 1	64 2	63	3 5	77 5	62 4	69 9	84	11	60	9		..	...	...	68 0	876.7	878 7	875 0	8 2	..
Mt. Darwin	3,179	71 1	66.4	64	5.8	80 8	65 8	73 3	87	12	60	9	5	...	17	...	71 8	.	...	...	8 1	..
Mount Nuza	6,668	57 9	56 5	56	1 3	64.1	53 4	58 7	72	12	47	9	...	27	...	...	57 1	799 9	876 5	.	9 1	..
Mtoko	4,136	68 0	64.1	62	4 6	75 3	62.0	68 7	82	20	58	9	...	.	...	.	67 3	875 8	879 4	874 3	8 0	.
New Year's Gift. .	2,690	73 5	66 8	64	8 2	82 9	63.7	73.3	93	19	58	10	9		8	...	...	...	..	...	.	4 3
Nuanetsi	1,547	76 3	70 0	67	8 6	86.1	67 9	77 0	99	19	61	10	16	...	18	...	...	959.1	879.6	...	7.2	...

DECEMBER, 1938 (continued)

Station	Altitude (Feet)	Temperature in Stevenson Screen at 4 feet °F: 8-30 a.m. Dry Bulb.	Wet Bulb.	Dew Point	Vapour Press Deficit	Maximum	Minimum	Max. + Mim ÷ 2	Absolute: Maximum	Date	Minimum	Date	Number of Days: Max > 85°	Max. < 70°	Min. > 65°	Min. < 40°	Mean of 24 hours	Pressure Millibars: 8-30 a.m. Station Level	8-30 a.m. 1200 gdm.	Mean of 24 hours	Cloud Tenths	Sunshine Hours
Plumtree	4,549	68.0	63.2	60	5.6	77.6	61.6	69.6	86	19	52	8	1	1	.	...	67.7	...	...	...	6.4	...
Que Que	3,999	67.9	64.4	62	4.3	78.5	62.5	70.5	85	11	55	9	...	...	2	...	68.5	879.8	879.0	878.3	7.6	...
Rusape	4,648	67.0	62.9	61	4.6	75.3	60.9	68.1	82	19	55	9	.	4	..	...	66.7			...	6.1	...
Salisbury	4,831	66.4	62.3	60	4.8	75.9	60.1	68.0	81	5	55	9	...	2	...	..	66.5	854.4	879.3	852.9	8.7	4.1
Shabani	3,131	71.9	66.3	63	7.0	81.7	65.0	73.3	93	20	55	9	9	1	17	...	71.0	...	...	...	7.9	...
Sinoia	3,795	69.9	66.2	64	4.6	78.9	63.7	71.3	85	13	59	10	...	...	3	.	69.5	.	...	...	7.2	...
Sipolilo	3,876	69.9	65.0	62	6.0	78.8	62.6	70.7	84	13	52	9	...	...	2	...	..	...	...	...	7.7	..
Stapleford	5,304	63.0	60.9	60	2.1	69.8	56.1	63.0	78	12	44	9	...	14	...	...	61.5	...	...	...	8.8	...
Umtali	3,672	69.0	65.5	64	4.3	78.8	62.7	70.8	88	20	55	9	3	1	1	...	69.2	890.5	879.3	889.2	7.5	...
Victoria Falls	3,009	72.6	68.5	67	5.3	84.3	65.8	75.1	94	12	61	10	12	...	20	...	72.5	..	...	...	7.4	..
Wankie	2,569	74.8	70.2	68	6.3	87.4	67.8	77.6	97	11	65	9	21	..	28	...	75.3	924.1	879.6	...	6.2	...
Abercorn	5,458	67.3	61.1	57	7.0	76.6	58.7	67.6	84	9	56	15	...	...	...	...	...	836.2	879.5	...	4.4	...
Broken Hill	3,911	68.1	65.1	63	3.6	80.1	63.5	71.8	86	6	60	12	2	..	4	...	..	882.5	878.7	...	7.9	...
Chipili	3,900	69.0	66.1	64	3.5	82.7	64.5	73.6	87	1	62	17	6	..	7	..	..	...	...	...	..	...
Fort Jameson	3,815	72.2	65.8	62	7.6	81.6	65.2	73.4	88	3	62	5	4	..	11	...	...	886.1	879.6	...	4.9	...
Kasama	4,562	67.2	63.9	62	3.8	79.7	62.3	71.0	84	1	58	10	..	...	...	..	..	863.1	879.7	...	...	...
Kasempa	4,500	65.5	63.5	63	2.2	79.8	60.9	70.4	85	22	58	28	..	.	...	...	...	..	...	...	...	...
Livingstone	3,051	70.3	67.8	67	3.0	82.9	64.9	73.9	90	12	60	10	8	...	17	..	.	908.3	877.7	906.7	7.8	...
Lusaka	4,193	67.3	64.5	63	3.3	77.7	62.8	70.2	84	13	60	9	..	...	..	.	..	873.1	878.3	...	8.4	...
Mazabuka	3,385	70.2	66.6	65	4.5	81.0	65.2	73.1	88	13	62	19	4	...	15	..	...	...	...	...	...	...
Mongu	3,481	70.7	67.8	66	3.8	83.4	65.5	74.5	89	12	63	11	9	...	19	...	...	894.7	877.7	..	6.8	...
Mpika	4,620	68.3	64.1	62	5.0	80.1	61.5	70.8	85	2	59	6	...	...	...	...	...	861.3	879.7	...	7.7	...
Mwinilunga	4,450	65.6	64.0	63	1.8	77.7	60.5	69.1	82	2	59	16	...	.	...	...	...	...	...	...	...	...
Ndola	4,190	67.4	64.7	63	3.2	79.4	62.4	70.9	85	26	60	9	...	...	...	...	...	874.0	879.0	...	7.3	...

Rainfall in December, 1938, in Hundredths of an Inch. Telegraphic Reports.

Area	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	Total	Normal
1	6	23	60	40	20	24	2		...	...	33	2	9	...	12	16	..		1	51	...	29	121	13	49	15	5	24	77	53	64	749	488
2	22	69	49	25	101	123	17	1	...	.		8	..	6	46	52	...		.	25	6	100	278	5	75	50	39	4	25	7	27	1160	536
3	54	4	34	38	211	40	10	4	1		1	...	30	.	27	66	...	...	6	121	23	59	96	67	91	101	8	93	66	38	6	1295	776
4	27	151	2	19	91	74	7	.	.		1	39	13	30	77	21	1	28	37	45	20	115	237	42	58	41	35	115	29	15	29	1399	679
5	54	10	77	17	1	63	2	.	.	...	2	28	4	32	38	33	...	11	.	93	79	20	100	31	28	27	3	39	26	42	52	912	553
6	13	148	36	11	28	171	52	...	..	.	41	7	10	15	62	40	93	9	56	78	118	181	69	14	69	103	2	91	23	23	17	1580	718
7	54	1	131	8	146	9	22	1		8	20	15	8	14	62	29	70	10	5	96	72	69	37	38	66	74	33	96	20	16	19	1249	682
8	34	18	73	19	41	106	44	13	...	1	18	20	6	3	6	116	94	97	9	59	104	46	117	59	164	186	78	125	17	3	36	1712	719
9	15	34	50	40	52	65	36	2	16	1	1	8	21	12	27	36	39	8	27	72	148	10	100	12	153	220	56	124	18	1	5	1409	648
10	3	1	128	5	23	1	1	1	1	1	7	35	23	3	37	25		53	99	95	54	23	9	89	101	7	69	59	13	36	121	1123	639
Mean	26	50	63	23	53	70	18	1	2	1	14	15	10	14	40	35	26	13	19	68	62	64	124	26	74	72	26	55	33	26	38	1171	606

Southern Rhodesia Veterinary Report.

NOVEMBER, 1938.

DISEASES.

Anthrax was diagnosed on Swartfontein farm, Victoria district. All cattle and sheep on the farm have been inoculated.

TUBERCULIN TEST.

Twenty bulls were tested with negative results.

MALLEIN TEST.

Seven horses, 14 mules and 4 donkeys were tested during the month. No reactions.

IMPORTATIONS.

From United Kingdom.—Bulls 1, horses 2, pigs 5.

From Union of South Africa.—Bulls 17, horses 1, mules 14, sheep 1,720.

From Bechuanaland Protectorate.—Horses 1, sheep 339.

EXPORTATIONS.

To Union of South Africa.—Oxen 226, cows 10.

To Northern Rhodesia.—Horses 1, bulls 1.

To Belgian Congo.—Horses 2, bulls 1, cows 37, sheep 125.

To Portuguese East Africa.—Bulls 10, cows 120, oxen 167, sheep 42.

EXPORTATIONS—MISCELLANEOUS.

To United Kingdom.—Chilled beef quarters, 3,603; frozen boned beef quarters, 1,332; kidneys, 466 lbs.; tongues,

4,053 lbs.; livers, 14,472 lbs.; hearts, 2,120 lbs.; tails. 786 lbs.; skirts, 1,277 lbs.

To Northern Rhodesia.—Beef carcases, 156; mutton carcases, 16; veal carcases, 43; offal packages, 204.

To Belgian Congo.—Beef carcases, 404½; mutton carcases, 20; pork carcases, 56; veal carcases, 13; offal packages, 6,362.

Meat Products—from Liebig's Factory.

To Union of South Africa.—Corned beef, 115,200 lbs.; beef fat, 7,000 lbs.; tongues, 4,170 lbs.

To United Kingdom.—Meat extract, 17,019 lbs.; beef powder, 34,580 lbs.

B. L. King,
Acting Chief Veterinary Surgeon.

SOUTHERN RHODESIA

Locust Invasion, 1932-38.

Monthly Report No. 73. December, 1938.

Flying swarms of the Red Locust (*Nomadacris septemfasciata* Serv.) was described as large and all either fully matured or approaching maturity, were reported during the month from seventeen districts in the Colony as follows:—

Mashonaland.—Charter, Chibi, Darwin, Hartley, Lomagundi, Makoni, Mazoe, Mtoko, Melsetter, Ndanga, Umtali and Victoria.

Matabeleland.—Belingwe, Bulawayo, Bulalima-Mangwe, Gwanda and Insiza.

Egg-laying, which commenced at the end of November, was reported from six districts in Mashonaland, namely:—Chibi, Darwin, Hartley, Melsetter, Mtoko and Umtali, and one district in Matabeleland, namely, Belingwe. Egg-laying in the northern portion of the Darwin district has occurred on a large scale.

The first hopper swarms were reported from the Umtali district on the 19th inst. and from the Mtoko district on the 30th.

It would appear that the swarms invading the eastern districts from Portuguese East Africa were more advanced than the swarms originating in Southern Rhodesia.

Locust birds have been following many of the flying swarms.

Little damage has been reported generally, although 100 acres of maize was destroyed on one farm.

J. K. CHORLEY,
Acting Chief Entomologist.

NOTICE

The Agricultural Journal of S. Rhodesia

is issued by the Department of Agriculture, and can be obtained upon application to the Editor. The Annual Subscription, which must be paid in advance, is 5/-, and payment may be made by any means other than by stamps.

A 10/- note will cover the subscription for two years.

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If payment is made by a cheque drawn on a bank outside Rhodesia, commission must be added.

All cheques and postal notes must be made payable to the Secretary for Agriculture and Lands.

Date..........................19.....

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Department of Agriculture and Lands,
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THE RHODESIA

Agricultural Journal

Edited by the Director of Agriculture.
(Assisted by the Staff of the Agricultural Department).

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Editorial.

Contributions and correspondence regarding subjects affecting the farming industry of Southern Rhodesia are invited. All communications should be addressed to:—The Editor, Department of Agriculture, Salisbury. Correspondence regarding advertisements should be addressed:—The Art Printing Works, Ltd., Box 431, *Salisbury.*

Mares and Stallions for Breeding Purposes.—Information has now been received from the General Manager of the Rhodesian Railways that mares and stallions for breeding purposes are now included in the same class as other breeding stock. Under the arrangement previously agreed to cattle and pigs (pure bred, registered or unregistered, males and all females), and sheep (all ewes and approved rams) consigned for breeding purposes, are charged at full rates in the first instance, but on submission of a certificate signed by the purchaser of the stock, a District Veterinary Surgeon and by the person paying the railage (in case where railage is not paid by the purchaser of the animals), a rebate down to half

rates is allowed. It has now been decided to extend this concession to mares and stallions consigned for breeding purposes.

The thanks of this Department and of all breeders of horses in the country are due to the General Manager for his assistance in this matter.

Baiting of Locust Hoppers.—Some amendments to previous suggestions for the baiting of Red Locust hoppers with moistened poisoned maize meal appear elsewhere in this issue. Baiting in lands and on the veld met with a moderate amount of success last year. Some of the failures were attributed to covering an insufficient area around swarms of hoppers, having too little moisture in the bait, and failure to spread the bait in such a manner that it would stick to the plants. Some of the most successful applications were made in the early morning when there was dew on the plants. A limited number of bags of the ready mixed bait now being used extensively in the Union of South Africa has been purchased by the Department for trial under Southern Rhodesian conditions. This is prepared with a different carrier and needs only the addition of water. Supplies are available for issue to farmers. The Department will be glad to receive reports from farmers on the results of baiting, whether they have used home-mixed bait or the new bait imported from the Union.

Cleanliness Hints.—The hints on agricultural cleanliness given in these pages last month apply also for March. The fact that these recommendations are the same for the two months does not mean that they may be postponed from February to March—they apply to *both* months. But if they were not acted upon in February, immediate action can still help matters—"Cleanliness Aids Insect Control."

Tobacco Mosaic.—Mr. F. E. Denny, of the Plant Research Institute, New York, wrote in a recent article in *Industrial and Engineering Chemistry*, that when the commonly used

commercial varieties of tobacco, *Nicotiana tobacum*, became infected with the mosaic disease, the virus is soon distributed to nearly all parts of the plant, and the spread of the disease from plant to plant is rapid. Plants of the species *N. glutinosa*, however, can take the disease, but the invaded tissues are killed so quickly at the place of entrance that the virus becomes localised in small spots and is unable to spread further to other parts of the plant; this effectively prevents or retards the spread of the disease from plant to plant. Holmes, Rockefeller Institute, Princeton, N.J., has introduced this valuable characteristic into common tobacco by cross pollenation and backcross breeding. The direct cross of *N. glutinosa* on *N. tabacum* gave sterile hybrids which stopped the breeding process, but by using another species, *N. digluta* (derived from *N. glutinosa* and similar to *glutinosa* in its response to virus infection), fertile hybrids were produced in which the desired character was introduced into commercial varieties of tobacco. With one variety, Sansoun, all of the 702 plants of the F_3 and F_4 selfed generations bred true, which showed the capacity to respond to virus by localising the disease in spots. It seems feasible to use this method to improve the strains of tobacco found suited to various localities by incorporating into them this hereditary trait which not only prevents the spread of the disease within the plant and from plant to plant, but assists in eliminating the carry-over of virus from one year to another.

Grades of Beef for Export.—The following descriptions of grades of chilled beef for export overseas are published for general information:—

Imperial Grade Chilled Beef.

Imperial grade chilled beef shall be derived from steers or non-pregnant heifers not over four years of age. The quarters must be plump and well fleshed, covered with an even covering of firm white or creamy white fat; the kidney and channel fat must be well developed and there must be a liberal distribution of fat in the lean at the point of quartering.

The beef must be properly dressed, free from objectionable bruises or taint, bright and sound in condition.

STANDARD A GRADE CHILLED BEEF.

Beef derived from steers and non-pregnant heifers not over five years of age, i.e., which do not show any pronounced ossification of the spinal processes or in the lumbar region. The quarters should be plump and well fleshed. The development of internal or external fat may be somewhat less developed than in the Imperial grade. There must be a fair distribution of fat in the lean at the point of quartering.

The beef must be properly dressed, free from objectionable bruises or taint, bright and sound in condition.

STANDARD B GRADE CHILLED BEEF.

Beef derived from steers and non-pregnant heifers not over six years of age, *i.e.*, do not show pronounced ossification of the spinal processes or in the lumbar region, though they may show more ossification than is allowed in Standard A Chilled Beef.

The quarters moderately well fleshed and moderately covered with fat with no pronounced areas of dark flesh over the rounds, loins, shoulders and ribs.

The beef must be properly dressed, free from objectionable bruises or taint, bright and sound in condition.

Deeds, not weeds, should be your goal.
Cleanliness aids insect control.

Fig 25.—*Hibiscus panduriformis* Burm. A common native Hibiscus which has nettling hairs on the stem.

Trees and Wild Flowers.

ON THE RHODESIAN FARM.

By CHAS. K. BRAIN, M.A., D.Sc., Director of Agriculture.

PART III.

Mopane and its Two Relatives. Fam. *Leguminosae.*—For a number of reasons Mopane is one of the best known trees in the country. Its leaves consist of two pointed leaflets which close together and are called "butterfly wings" by the children. Its timber is so hard and so rich in resin that it is ideal for building poles, as neither rain, sun, nor termites seem to affect it. It usually occurs where the soil is either very shallow, very brack or where it becomes quickly water-logged. Agriculturally it is a good indicator, as whenever Mopane occurs alone and the trees are small it is certain that the soil is unsuitable for crops, and as a rule even grass cannot grow there. An odd tree may sometimes be found among other forest trees on deep soil. In this case it attains a height of 40 to 50 feet and the trunk may reach two to three feet in diameter. Its scientific name is *Copaifera mopane* Kirk. (Fig. 19.) *Copaifera* is chiefly a tropical American genus, but about a dozen species are recorded from Tropical Africa, of which three occur in this country. The name means the producer of *copaiba*, the Brazilian name for gum-copal. The scientific name *mopane* was given by Dr. (afterwards Sir) John Kirk, who collected it when acting as medical officer to the Livingstone Expedition some eighty years ago. Mopane was the native name of the tree, and the manner in which it was spelt by Dr. Kirk should be retained rather than *Mopani*, *Mupani*, etc., which are commonly used. After heavy rains the tree produces masses of small flowers followed by its remarkable flat seed-pods. Flowers may appear as early as January, but April is the usual time.

Copaifera coleosperma Benth. "Mchibi," is one of the finest trees which is common near the Victoria Falls. (Fig. 20.) It occurs through Northern Rhodesia and Angola. It is a large evergreen tree with slender branches. It produces an abundance of small white flowers about March, which are followed by smaller and plumper pods than Mopane, each containing one large seed with a bright red aril. The wood is excellent and is sometimes called Rhodesian mahogany.

A third species, *Copaifera gorskiana*, Benth., occurs as a much-branched tree or bush around Wankie. Its leaflets are smaller and more rounded than Mopane, although the seed pods are somewhat similar. (Fig. 21.) These three species can be easily distinguished from a single leaflet, as the number of main veins which arise from the junction with the stem is different. In *coleosperma* there is only one, in *gorskiana* two to four, and in *mopane* six to nine, usually seven.

The Lantanas. Fam. *Verbenaceae.*—*Lantana Camara* Linn, is the common shrub or hedge plant with prickly stems, dark green ovate leaves and red and yellow flower heads. (Fig. 22.) It is a native of South America, but has been spread to most warm countries as a garden shrub or hedge plant. In Ceylon it spread from the gardens and became a weed of such importance that legislation was passed to secure its control. The bunches of shiny berries, which are black when ripe, are much relished by birds, and its spread to hedgerows and under trees is secured in this way. A large number of varieties and hybrids have been developed and are commonly cultivated in gardens and greenhouses. A variety with pale yellow, or almost white flowers, is fairly common in Salisbury and other towns. It can be found in flower during most of the year.

Lantana selloviana Link, is the small trailing lantana with pinkish or lilac flowers. This is also a native of South America. It is often grown in gardens as an edging border. It blooms profusely and is grown as a pot or basket plant in greenhouses in Europe and America. (Fig. 23.)

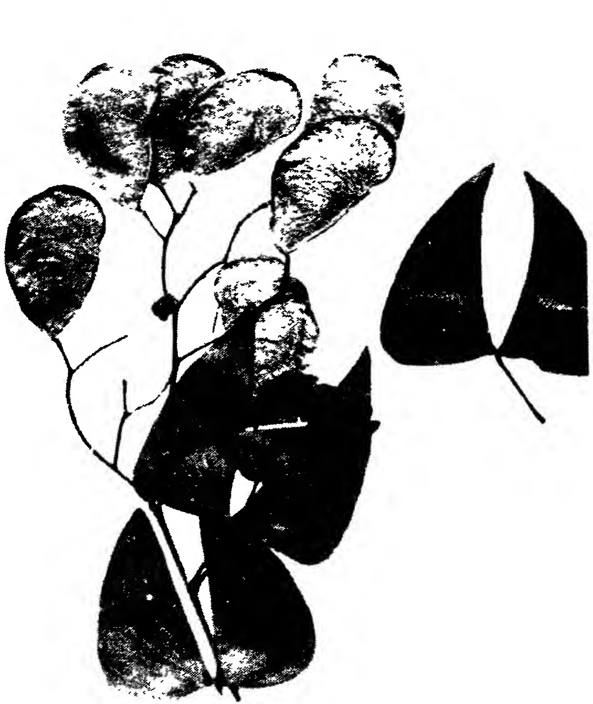


Fig 19.—*Copaifera mopane* Kirk Mopane in fruit.

Fig 20.—*Copaifera coleosperma* Benth "Mchibi," Victoria Falls. Flowering in March

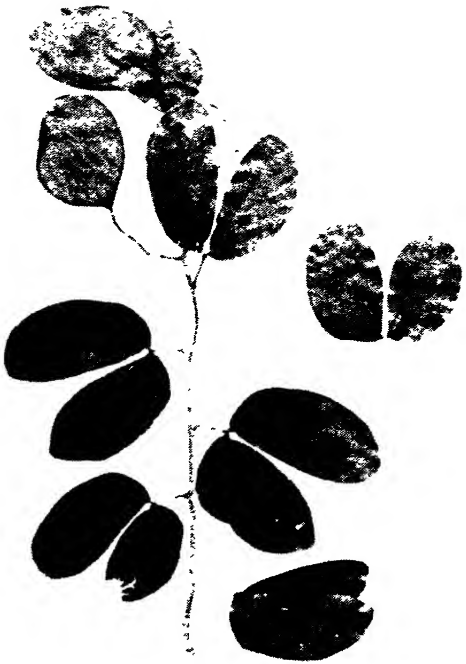


Fig 21 —*Copaifera gorskiana* Benth in fruit. Wankie.

Fig 22 —*Lantana Camara* Linn. the common Lantana in hedges.

Fig 23 —*Lantana sellowiana* Link The small straggling edging border plant

Fig 24 —*Lantana salvifolia* Jacq., the indigenous shrub.

Fig 26 —*Erigeron canadense* Linn The common weed of old tobacco lands

Fig 27 —*Sonchus oleraceus* Linn The common "Sow-thistle" weed of gardens

Lantana salvifolia Jacq., is an indigenous shrub common in most parts of the country. It is usually about three feet high, but may reach five feet under favourable conditions. The stems are not prickly. The leaves are smaller and narrower than in the cultivated lantanas, and the flower heads, which are at first globose, become elongated with a few very small white or pinkish flowers near the top. The fruits are in a small head and turn purple when ripe, and are collected by the natives for food in time of famine. It flowers from January onwards. (Fig. 24.)

Hibiscus panduriformis Burm. Fam. *Malvaceae*.—This is one of the commonest of our large, indigenous species of Hibiscus. It usually grows to about 5 feet high and the stems are thickly covered with short white hairs, amongst which are numerous irritating bristles. The leaves are stalked, roundish, lobed with crenulate margins. The flower bud has a series of 6-10 bracts outside the sepals, and the flower—which is yellow with a deep red patch at the base of each petal—varies from 3 inches to 5 inches in diameter. The old closed flowers are reddish. (Fig. 25.)

It is common and widespread, flowering most of the summer months.

Erigeron canadense Linn. Fam. *Compositae*.—This plant, the common "Fleabane" of its native land America, is becoming one of the most troublesome weeds of old tobacco lands. It produces such an abundance of seed which are scattered by wind that it now occupies hundreds of acres in the tobacco districts. It has been estimated in Canada that the average plant produces about 120,000 seeds. It is an annual, usually 3 to 4 feet high with branched stems, usually bristly hairy. The upper leaves are narrow and smooth-edged; the basal leaves are wider and dentate. The numerous small white flower heads never seem to open fully and are soon replaced by the characteristic thistle-down which is common in this family. (Fig. 26.) It is quite impossible to control this weed unless the plants are removed or cut down before the seeds are developed.

Sonchus oleraceus Linn. Fam. *Compositae.*—This is the common annual "Sow Thistle" which was introduced from Europe. The stem is not much branched and is usually from 1 to 4 feet high. The leaves are deeply cut and toothed with soft teeth, and their bases clasp the stem. The flowers are pale yellow and vary from ½ to 1 inch in diameter. The stems and leaves contain a milky juice. The seeds are supplied with thistle down and are distributed by wind. In gardens this plant grows and flowers in wet spots right through the year. (Fig. 27.)

Deeds, not weeds, should be your goal.
Cleanliness aids insect control.

Report on the Cattle and Chilled Beef Industries in South America

PART I.—BREEDING AND FATTENING IN THE ARGENTINE, URUGUAY AND BRAZIL.

By C. A. Murray.

In all I spent 50 days in South America—from April 22nd to June 11th, 1937. During this period I visited five Frigorificos (Anglo-Vestey at South Dock, Armour's at La Plata, Swift's at La Plata, La Blanca at Avellaneda, Liebig's at Colon) and twelve Estancias in the Argentine; four Frigorificos (Anglo at Fray Bentos, Nationale, Artigas-Armour's and Swift's in Montevideo) and two Estancias in Uruguay; and two Frigorificos (Anglo at Barretos and Armour's at Sao Paulo) and eight Fazendas in Brazil.

At the different estancias in these three countries I had an opportunity of studying the breeding and fattening methods followed in the best and worst cattle zones. In this connection the Liebig's organisation and the chief buyer of the Anglo were of considerable assistance to me in the Argentine and Uruguay and the Anglo organisation in Brazil.

At most of the frigorificos I visited I was given an opportunity of meeting the works managers and refrigeration engineers and discussed matters with them. On the whole I found them very helpful and willing to assist.

I propose discussing in this article the breeding and fattening of chillers in the Argentine, Uruguay and Brazil.

ARGENTINE.

The Argentine has a human population of approximately 16,000,000 and a cattle population of over 32,000,000 (1930 census), of which

18,000,000—56% are of Shorthorn breeding.
3,000,000— 9% are of Hereford breeding.
1,250,000— 4% are of Aberdeen Angus breeding.
800,000— 3% are of other breeds.
9,250,000—28% are of native cattle.

From the above it is obvious that the Shorthorn is the predominating beef breed. Although the American type of Hereford is becoming more and more popular, the Shorthorn is still considered the best of all breeds, especially for fattening as baby beef and two-year-olds.

Argentine has an area of about 1,100,000 square miles and extends from latitude 22° S. to 55° S. From this it follows that the climate and grazing conditions vary very considerably in different parts of the country. In the South it is extremely cold and on the whole the rainfall low. Sheep farming forms the main livestock industry in this part. In the better parts of this zone, adjoining the temperate zone, large number of feeder steers are produced.

The climate is temperate in the zone more or less central, which extends fanwise for a distance of 350-400 miles from Buenos Aires, including the province of Buenos Aires and parts of the provinces of La Pampa, San Luis, Cordoba, Santa Fe and Entre Rios. Ninety to ninety-five per cent. of the chillers fattened for export come from these parts. This zone is indeed the heart of the Argentine cattle industry, and without it there would certainly have been no chilled beef trade. Towards the west of this central temperate zone the rainfall is again low and fruit is the main industry. In these parts feeder cattle are, however, also produced.

In the northern zone sub-tropical and tropical conditions prevail and mostly native or Criolla cattle are produced and sold as canners. In the better parts, however, of the provinces of Missiones, Corrientes, Chaco, Santa Fe, etc., the better type of farmers on the better land produce high grade cattle

—mostly Herefords and Shorthorns. Under adverse conditions the Hereford is considered to do better than the Shorthorn. From this zone the calves are usually sold immediately they are weaned to farmers in the central zone for fattening on lucerne and winter cereal pastures.

The rainfall in this northern zone is an all-the-year-round one averaging from 40—60 inches.

The country here is slightly undulating, and although the rainfall appears to be ample and well distributed, the soils are rather poor and shallow in parts and consequently the quality of the grazing is not very high—especially during the winter month. New growth usually commences about August or September, and the grazing, provided it is kept fairly short, maintains its feeding value at a fairly high level until March or April. After that cattle, especially young stock and lactating cows, fall off in condition very much unless grazed on winter cereals, which is usually not possible, except for a few selected animals, such as bulls.

The carrying capacity in these parts varies, depending on the amount of fencing, etc., from 5—8 acres per mature animal when both cattle and sheep are run.

In this zone, as pointed out above, the poorer type farmers produce inferior type, unimproved cattle which they dispose of to canning and extract factories such as Liebig's and Bovril, at about 9s. 8d. (15-17 cents per kilo) per 100 lbs. liveweight at the factory.

The better animals produced in this zone are practically pure bred, as nothing but good pure bred bulls have been used in the herds for many generations.

In these high grade herds I saw, the mature animals were surprisingly well grown and of good type and quality. With the use of 4-5% of bulls a 70% calving is common, but because of foot and mouth disease, blowfly and piroplasmosis (red water) it is usually reduced to 55% at weaning.

The calves reared are of exceedingly good type and quality and well developed.

I estimated the average weights of 8-9 months old steer calves at least 400 to 430 lbs. or over as they were running. These calves were just ready to be weaned straight into the train and sent to the province of Entre Rios in the temperate zone for fattening to be ready as chillers at 2 to 2½ years of age.

In the northern zone the growth made by young stock is very disappointing, especially during the two years after weaning, *i.e.*, until they are three years old. During this period they make very much the same growth as similar animals under ranching conditions in Southern Rhodesia.

Heifers are usually served when just over three years. During their fourth year, *i.e.*, until they are four years old and calve, they make most remarkable growth. (Fig. 1.)

The most critical stage, therefore, seems to be between weaning and three years of age.

On the estancias I visited in this area a certain percentage of lactating cows were suffering from a phosphorus, and probably also, calcium deficiency. The extent to which the young stock suffer has not yet been determined, but they show no clinical symptoms and the feeding of mineral supplements made no difference to their rate of growth. It has been found, however, that allowing lactating cows free access to a lick consisting of 50% bonemeal, 30% slaked lime and 20% salt is of great assistance in preventing them from "breaking down." I actually saw some suffering cows and the symptoms, which usually commence a few months after calving, were as follows:—

After calving they lose condition fairly rapidly, become stiff in the joints, appear to be sore-footed and walking on their toes and give short steps. The joints are not enlarged. They usually stand and walk with their backs arched, walk with an unsteady gait, and when forced to run do so with great difficulty. They usually get worse until they die. When cattle are collected in the paddocks the affected cows have to be left behind as they cannot keep up with the rest of the herd. As soon as the cows commence suffering their milk yield decreases and the calves go back.

Fig. 1.—Hereford heifers rising 4 years in calf in the Province of Corrientes in Argentine

Fig. 2.—Steers of Zebu type being fattened on Gordura pasture in Brazil.

Two methods are usually used to cure affected cows, *viz.*, (*a*) when taken out before too far advanced the daily administration of 4-5 ozs. of bonemeal for a few months effects considerable improvement, (*b*) killing the calf. The cow will then recover in a few months.

The central or fattening zone to which reference has already been made extends fanwise from Buenos Aires and is entirely different from the breeding areas in the South, West and North. In this zone very few indigenous grasses are seen, and one travels by car for miles and miles without seeing anything but lucerne and/or Sudan grass and/or maize for grazing, and in April, while I was there, winter cereals—especially rye, and oats—as well.

In this zone the country is absolutely flat, with a well distributed all-the-year-round rainfall—although less in winter than in summer—of 30-40 inches. Droughts are practically unknown, although dry spells are often experienced during the winter months. The soil is very easy to work, of great depth—up to 100 feet—and unbelievably rich. I saw land which had been under lucerne and cereals for fattening cattle for over 50 years that still gives the same, or even better, growth than ever, without ever having been fertilised.

The majority of estancias are large, but usually very well paddocked, and the practice is to graze the cattle on lucerne pasture from September to March or April and from then on until August on winter cereals—especially oats and rye. In some parts wheat is used instead and first grazed and then allowed to go to seed, when a good yield is still obtained. Rye is considered more drought-resistant than oats and the cattle also scour less on it. I went over estancias where practically every inch was under lucerne and winter cereals and large numbers of cattle grazing on it.

The establishment of lucerne pastures costs nothing, as it is usually put in with linseed as a cover crop, and this gives an immediate cash return well above the cost of planting. Depending on the soil lucerne will do well for 6-15 years on the same land. When it becomes too old it is ploughed up in late summer and followed by rye or oats for grazing until August, Sudan grass or maize for grazing to March, and

then again either to lucerne or another season to winter cereals followed by Sudan grass and maize.

Feeders usually arrive from the breeding areas when 9-13 months old, and after 8-12 months fattening on these pastures are ready as chillers at the age of approximately two years and dressing 600-650 lbs. There is at present a tendency to get calves directly they are weaned at 8-9 months of age and produce baby beef.

In this zone a large amount of steer breeding is also done, but in the best parts land is considered too valuable for this purpose. The majority of steers bred there can very easily be, and many are, fattened for export as baby beef. I saw many 8-9 months old calves grazing with their dams on lucerne and just ready to be weaned on to beautiful oats and rye pastures. At this age their estimated liveweights were 600 lbs. and it was considered that they would be ready as chillers at the age of 18-20 months and dress 600 lbs.

During my visit the very best chillers weighing on arrival at the factory between 460-500 kilos (1,000-1,100 lbs.) liveweight sold at 27 cents per kilo liveweight, which is about 16s. 4d. per 100 lbs. liveweight, or about 26s. 4d. per 100 lbs. dressed weight—dressing percentage 62%. This was the best price received for a considerable period and cattle farmers were very prosperous.

The growth made by cattle in this zone is simply wonderful, and to see mobs of 500 1½-2 years old steers, all dehorned*, of the same size, type, colour and breeding is something I should not think seen in any other part of the world.

It was also of great interest to see some commercial breeding herds in the fattening zone. On one large estancia I saw a herd of 1,400 high grade—practically pure bred—Hereford cows. They were of uniform type and certainly the largest cows I have ever seen. Cows suckling calves were in practically the same condition—fat—as dry cows, and a lactation seems to have very little effect on them. With the use of 3-4% of bulls the average calving percentage was between 80 and 90%. Bulls never receive any supplementary feeding.

*The frigorificos refuse to buy chillers with horns.

Although the conditions seem to be so absolutely ideal for cattle it will be appreciated that the production of large numbers of chillers of the same type, quality and breeding is not simply a question of putting the bulls with the cows. From what I saw and heard great care is taken with the selection of bulls and the breeding stock are regularly culled for type and fertility. The bulls used are good, and it is well known that Argentine breeders have for many years consistently imported the best blood from England and Scotland. Even to-day, while there are enormous herds of very good pedigree Shorthorns, Herefords and Aberdeen Angus—probably as good as any in Great Britain—fresh blood is still being brought in in large numbers.

When fattening cattle on these pastures the feeding of grain is unknown, except to show animals. Oats and/or maize and linseed are usually fed to these. With such feeding I saw some cows with their first calves and the latter weighing on the average 837 lbs. at eight months. These were being prepared for the Buenos Aires Fat Stock Show, and as the owner was afraid that they would be too heavy at the time of the Show when they would be 14 months old, the grain ration had already been reduced.

The chief buyer of the Anglo saw them with me and he estimated that they would dress between 650-700 lbs. at the time of the Show—when 14 months old!

The summer growth of lucerne is usually far in excess of what can be utilised, and during the last few years more and more farmers have commenced ensiling (without molasses) this surplus material for use during the autumn or winter months. The lucerne is cut when it comes into flower and simply dumped uncut into pits and covered up with earth. These pits are usually along the sides of the paddocks where the silage is fed to the cattle on the ground. This conservation of surplus summer feed has already increased the carrying capacity of some already heavily-stocked estancias. Similarly large quantities of hay are made of surplus lucerne in summer.

As the farmers annually require large quantities of winter cereal seed they usually grow it themselves and the straw obtained is stacked in the fields and the cattle allowed to eat it—which they do quite freely—before the winter cereals are ready for grazing. I actually saw cattle eating it quite freely, and it is considered to prevent the animals from scouring too much when slowly accustomed to the young green cereals.

URUGUAY.

The population of this small country is about 2,000,000, of which more than one-third live in its capital—Montevideo. The last cattle census was held in 1920, when there were just over 7,000,000 head of cattle in the country. Of this number it is estimated that 4,000,000 (57%) are Herefords, 2,000,000 28%) Shorthorns and the remaining 1,000,000 (15%) of the other breeds, including dairy cattle.

The area of Uruguay is 72,153 square miles and it lies on the east coast of South America, just north of the province of Buenos Aires, across the Rio de la Plata—between latitude 30° S. and 35° S.

Although it is only separated from the fattening zone of the Argentine by this river, the grazing conditions are very different and inferior, chiefly because of the poorer and shallower soils. It enjoys a good rainfall of 30-60 inches distributed more or less as in the northern provinces of the Argentine.

Because of the poorer grazing conditions the quality of Uruguayan cattle, especially chillers, is definitely inferior to those produced in the Argentine. The northern and north-western parts are generally considered more suitable for breeding than fattening, but the practice to breed in the poorer parts and fatten in the better parts is not yet so strong as in the Argentine.

As pointed out, the most popular breed is the Hereford. They are considered hardier and more suitable for Uruguayan conditions than the Shorthorn, which is slowly being replaced by it.

Because of the poorer soil conditions comparatively small areas of winter cereals are grown and practically no lucerne. For summer grazing Sudan grass is used for fattening purposes. Considerable use is also made of natural indigenous pastures, especially for sheep and cattle not being fattened.

The average age of chillers exported from Uruguay is 3-3½ years, *i.e.*, about 12-18 months older than from the Argentine. Apart from being older Uruguayan chillers are of poorer type and quality than those from the Argentine.

At the time of my visit to Uruguay farmers were receiving the equivalent of 20 cents per kilo liveweight, *i.e.*, about 12s. per 100 lbs. liveweight at the factory, or 20s. per 100 lbs. dressed (dressing 58-60%)—and they were also satisfied and doing well.

BRAZIL.

This vast country has a population of 42,000,000 and an area of 3,286,170 square miles, of which most is still undeveloped. The last census held in 1931 showed a cattle population of over 45,000,000.

In the extreme south, in the province of Rio Grande de Sul, the pastoral conditions and types of cattle bred are very similar to those found in Uruguay, which it adjoins in the south. In this province mostly Herefords are produced and chilled beef exported *via* Montevideo.

North of this province and over the rest of Brazil the British beef breeds are practically non-existent. Near the bigger cities and towns dairy cattle, such as the Friesland, Brown Swiss, Jerseys and Caracu* are found in fairly large numbers and do well if well fed and housed.

In different parts of the country grazing conditions vary very much. This can be understood as the climate varies from temperate in the extreme south to sub-tropical and tropical in the north. The country actually lies between latitude 5° N. to 33° S. In parts the grazing is extremely

*The Caracu is a breed developed in Brazil. It is dual purpose—trek and milk—but not outstanding in the latter respect. It is considered an inferior beef animal.

poor, such as in the provinces of Matto Grosso, Parana, Bahia, etc., where the carrying capacity is often as low the 15-50 acres per mature animal. Over most of the country the rainfall is practically an "all-the-year-round" one with more during the summer than winter months. The following gives an indication of the average rainfall (1931-36) and its distribution in one of the worst cattle zones—Matto Grasso:—

Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.:	Total.
3"	$3\frac{1}{2}$"	$5\frac{1}{2}$"	7"	7"	$5\frac{1}{2}$"	3"	3"	$\frac{3}{4}$"	$\frac{3}{4}$"	$\frac{1}{2}$"	1"	$40\frac{1}{2}$

The quality of the pasture, especially the natural grazing, also decreases very considerably during the winter months, but generally the cattle have good green grazing from August and September to March or April. In the worst parts even the summer grazing is of poor quality.

In Brazil the tendency is already to breed cattle in the poorer areas for fattening on better pastures such as in the provinces of Sao Paulo, Minas Geraes, Goyaz and Rio de Janeiro.

I fortunately had an opportunity of visiting four fazendas (estancias) in the province of Matto Grosso. The carrying capacity varied from 30-60 acres per animal and either Guzerat or Indu Brazil Zebu bulls were being used on small poor type local cows, some of which already showed signs of Zebu blood. Of thousands of head that I saw I considered 90% most disappointing.

Although it was at the end of summer the majority were in poor condition and the lactating cows just about wrecks. The calves, too, were small, thin and undersized. The cows with calves actually get so thin that calving percentages vary from 30-50% when even up to 8% bulls are used. Usually the cows calve every other year and give 3-4 calves per head before they have to be culled. Heifers cannot be bred before they are three, or often four, years of age. All the calves I saw were so small and thin that I thought they would never develop into good quality steers. If left to mature in those poor parts they barely reach satisfactory weights and finish for the local markets of Santos, Sao Paulo and Rio de Janeiro and never become chillers. However, if taken away as $3\frac{1}{2}$ year olds and fattened on good pasture for twelve months

they usually kill about 530 lbs. as 4½ year olds. I saw a large number of these steers and they were of very average quality and mostly used for the local market. On the other hand again *if those small, undersized, thin calves are weaned straight into the trains and taken to the fattening areas their further development is simply amazing, and at three and a half years they are ready as first class chillers dressing* 570-580 lbs.

I saw hundreds of calves just before they were to be weaned and sent off to the better pastures and then again on the fattening pastures the previous three years' weaners from the same fazenda, but which had each year been sent there after weaning. The growth made by these and their condition and quality were so outstanding that I could hardly believe that they were from the same place. Even those that had been on the good grazing for only 10 months were in beautiful, sleek and thrifty condition. Those a year older were still better and the chillers compared *very favourably* with the well bred steers which had been bred and fattened on the better pastures. (Fig. 2.)

I have always appreciated the importance of good nutrition for young stock after weaning, and although our experimental work at the Matopos has given very conclusive proof of this, it has never been demonstrated to me so conclusively as with these cattle. *If we could only move the calves being bred at present on our Southern Rhodesian ranches to parts of the country where they could receive some form of supplementary feeding during the winter months on the lines indicated by our Matopos experiments—as our summer grazing is as good as the best in Brazil—I have little doubt that the quality of our chilled beef would go up by* 40-50%. *This question of better conditions for our weaners is without doubt most important if we wish to produce and export better quality chilled beef than at present.*

As pointed out previously, the beef cattle bred in the better parts of Brazil, except in the extreme south where grades of the British breeds can be run, are all either high grade Zebus or native cattle carrying varying percentages of

Zebu blood. The best quality Zebu cattle are at present found in the provinces of Minas Geraes, Goyaz, Sao Paulo and Rio de Janeiro, while grading up with the Zebu is taking place in most of the other surrounding States and further away. The breeds most commonly found are the Guzerat, the Gyr and the Nellore.

As the Guzerat is considered rather long on the leg and the Gyr again a bit too small, the two breeds are now being crossed very extensively with the hope of establishing a new breed which is already being called the "Indu Brazil."

There is, however, nothing systematic about the work, so that it is very unlikely that a breed will ever be developed that will breed true.

Although it was perfectly obvious to me that no grades or crosses of the British breeds would do in the poorer parts because of the very poor environment (poor quality natural grazing, heat, rays of the sun, warble fly, etc.) I felt, looking at things as an outsider, that on the better parts where Jaragua (*Hyparrhania rufa* Staple) and Gordura or molasses grass (*Melinis minutiflora*) pastures had been established it should be possible to run better type and earlier maturing cattle than the Zebu. I discussed this with everybody I met, among whom were a number of Brazilian farmers, and the cattlemen and stockmen—some with very wide experience—of the Anglo. Every one was quite emphatic that cattle carrying blood of the British breeds would not do. It had apparently been tried in the past, and although the first crosses in most cases did well, they never even did as well as the Zebu, and subsequent crosses were invariably a failure. The bulls also were very much more expensive than Zebu bulls and had to receive extensive care and supplementary feeding.

As the Zebu cattle grow and fatten so exceedingly well on the Jaragua and Gordura pastures I presumed that the grazing must be of very high feeding value. I, therefore, tried to find the reasons why grades of British breeds crosses would not do. The following are the reasons given to me by many:—

(*a*) *Blow Fly.*—Any open wound, or even a small scratch, is struck by blow fly and very soon becomes infested with maggots. Calves just after birth, especially grades of the British breeds, get their navels infested with these maggots and have to be treated for up to ten days. The Zebu calves are said to suffer much less and are also easier to cure.

(*b*) *Warble Fly.*—This is another very troublesome parasite and practically all the cattle were infested. The thinner and less dense hide and long hair of the British grade apparently make the animals more susceptible to this infection and they also suffer much more from the intense irritation which it causes than the Zebu.

(*c*) *Unthriftiness.*—I was often told that grades of the British breeds suffer from what was called "sunstroke." Effected animals apparently just don't do and appear unthrifty. It seemed to be partly caused by the same factors that cause too finely bred cattle in Southern Rhodesia to be unthrifty, although with us nutrition is certainly a major factor and not there on the good pastures. To me the main cause of this unthriftiness seemed to be the high temperatures and humidity experienced in the northern cattle producing parts of the country. It is now an established fact that high external temperatures and humidity influence the metabolic level of European and Indian (including Africander) cattle differently. The Zebu, having many more sweat glands per unit area than the British breeds, perspires freely and so eliminates excess body heat in order to maintain normal body temperature. The long hair of the British grades also hinders very much both radiation and conduction of heat from the skin. The pigmented skin of the Zebu is also a definite advantage.

It was pointed out previously that the tendency and practice was to breed cattle in the worst parts for fattening in the better zones. In these better areas large numbers of cattle are both bred and fattened and considerable attention is given to the question of pasture improvements. In this

connection two grasses are of great importance, viz., Jaragua and Gordura (means fat). Both seed freely and are easily established from seed.

Jaragua is mostly used for early spring, summer and even autumn grazing and fattening and it gives heavy yields of nutritious grazing. It does not suffer from burning, which is one of its virtues as, to provide early, young, nutritious grazing it is regularly burnt in July or August and again December or January for later grazing. Gordura is also a good summer grass and very extensively used, but it is better than Jaragua during the winter months. It is a beautiful leafy, very soft grass, but suffers very much from veld burning.

On the better managed fazendas the ideal seems to be to have approximately one half of the paddocks of the one grass and one half of the other.

The carrying capacity of the two grasses is very high—about two acres per mature animal per annum. I actually visited one place where 7,000-8,000 chillers had been fattened the previous year on 15,000 acres.

In the better parts the establishment of these pastures was rather expensive, as the better soils were all covered with heavy virgin tropical forest. At present, however, the cost of clearing land and establishing these pastures is practically nothing on account of the high price of cotton (June, 1937). Usually the work is either given out on contract—the contractor being allowed the use of the cleared land, on which he grows a profitable crop of cotton, for two years. In the other case the farmer clears it himself and grows cotton, which will in one season pay for the cost of clearing and the establishment of the pasture.

In the parts where these good pastures have been established farmers either breed and fatten their own feeders or do fattening only and buy either yearling, 2½ or 3½ year old steers and run them until they are ready either as chillers or locals. The following were given to me as average prices paid for such feeders during the last six months:—

Yearling calves... ...	55- 80 milreis	=15/0—21/0d.
Two year olds	100-150 milreis	=25/0—40/0d.
Three year olds... ...	200-250 milreis	=53/0—67/0d.

These prices are considered the highest paid for many years.

It is usually possible to get yearling calves off as chillers as 3-3½ year olds, and for their youth I was surprised to see how exceedingly well the carcases were finished.

On one of the Anglo fazendas which I visited I saw several thousand 3-3½ year old Minas Geraes-bred steers being fattened. These were a very uniform lot and supposed to be above the average for conformation and quality.

I had an opportunity of seeing their fattening results and the following were the particulars of one lot of 500 which had just been sold. They were purchased in January, 1937. They were then in fairly good condition and estimated to weigh 400 lbs. dressed. They were run on good pasture until May and sold as chillers dressing 530 lbs. On grading the meat hindquarters from 80% were passed for export. The seller was paid the equivalent of 19s. per 100 lbs. dressed weight for the lot, *i.e.*, £5 each. This gave £1 17s. 0d. per steer above the purchase price, and as fattening cost the company 1s. 3d. per head per month* the profit was £1 10s. 9d. per head—and they fatten thousands each year.

It was pointed out above that hindquarters from 80% were passed for export. This figure usually varies between 55—80%.

It will be seen that the prices paid for feeders of the different ages, and even for chillers, are much lower than what they can be bought for in Southern Rhodesia. I discussed these figures with a large number of interested persons and all were of the opinion that they were very satisfactory and that the farmers were doing very well out of the business. The reasons for this appear to be the low cost of land and the low standard of living of most farmers and the cheapness of living in Brazil.

*This includes all expenses, interest on capital invested, etc

(To be concluded.)

COMPOST

By S. D. TIMSON, M.C., Assistant Agriculturist.
Revised February, 1939.

[*This article was first published in the November,* 1937, *issue of this Journal and reprinted as Departmental Bulletin No.* 1048. *The edition of the latter having been exhausted, it is republished, and the opportunity has been taken to add to and revise it in the light of further experience.*]

Introductory Note.—The process of making compost is essentially a simple and elastic one from the practical farm stand point, but the desirability of assisting farmers to adjust it to suit their own particular conditions has forced the writer to elaborate certain aspects so that they may understand how to do this.

The farmer who does not want to know what happens inside the compost heap, and is not particularly anxious to achieve a perfect product in the minimum time, need merely read those sections describing the actual handling of the materials or the proportions of them required.

The writer has found, however, that many farmers are also keenly interested to understand what is happening during the process of decomposition, so that they can the more intelligently utilise the resources of their farms in the way of raw materials to the best possible advantage, and for this reason he has included a brief description of the processes of decomposition of the organic matter and a discussion of the ways and means of speeding up or retarding those processes and making them as economical as possible.

The article has therefore been arranged in sections with the hope that readers can find what they require and neglect the rest without waste of their time.

Section III. deals with a suggestion the writer makes for composting the sunnhemp crop, with the object of reducing the proportion of land idle under green-manure.

Definition.—Compost is the product obtained by the rotting of organic waste materials, chiefly vegetable in origin, by the action of fungi and bacteria, with the ultimate formation of humus.

The Origin of Compost.—The employment of compost in agriculture is no new thing, since a method for its manufacture from animal droppings and various crop wastes is described by Ibn-el-Awam in his book on Nabathean Agriculture written in the 6th century.

Marcus Cato, 234-149 B.C. relates the Roman practice in composting farm wastes, and urges the farmers, on farms unable to support livestock, to collect all the crop wastes, leaves and weeds from hedgerows, ferns and sweepings, and mix all these with sewage and straw in a pit.

From ancient times too the fertility of the soil in China has been maintained at a high level by the use of compost made from animal and vegetable wastes, or green crops, fermented in layers with mud from the canals and rivers. Every scrap of organic waste is preserved for this purpose. Nothing is wasted.

The research of Hutchinson and Richards demonstrated that crop wastes could be composted with only inorganic sources of extra nitrogen, and this resulted in the placing on the market of the Adco process. The obstacles to this process being generally adopted in Rhodesia have proved to be (1) the necessity for an artificial water supply, (2) the necessity for using materials which are not obtainable on the farm and are rather costly.

Sir Albert Howard, and his co-workers, at Indore, later worked out and introduced a method of composting crop wastes in a reasonably short time (three months), and without the need to purchase any materials from off the farm.

The modifications and improvements on this method worked out by Jackson, Wad and Panse, which simplified the making of compost from crop wastes with the use of rain only as the source of moisture, and which introduced the ingenious method of providing additional nitrogen supplies by growing a legume on the heaps, resulted in a simplified process, which fits in admirably with the requirements of Rhodesian agriculture. This process, with some modifications by the writer to suit local conditions, was published in the February, 1936, issue of this Journal.

Since then many farmers all over the Colony have adopted it, and increasing interest in it is being evinced. The writer considers that it presents a solution, or partial solution, to several important problems of Rhodesian agriculture, and this aspect of the matter will be discussed later in this article.

SECTION I.—TECHNIQUE OF COMPOSTING.

A. RAIN-WATERED COMPOST.—Detailed technique.

Materials Required.—(1) *Vegetable matter of any kind*, such as maize trash of all kinds, including the cores; dry or green grass; spoilt hay or silage; stalks of sunflowers, cotton and sunnhemp after threshing; wheat, barley, and oat straw and chaff; leaves of trees, including gums, and scrub bush; saw-dust, waste paper, and rags in limited quantities; the top-growth of the sunnhemp crop. All green materials should be withered before use for a day or two.

(2) *Dung* of cattle, horses, sheep, goats, pigs and poultry.

(3) *Ordinary field soil*—top seven inches only. Where soil soaked in urine is obtainable this is to be preferred, since it contains much nitrogen. It can be collected from cattle kraals, collecting yards, cow byres, etc.

(4) *Wood ashes or agricultural lime.*—Wood ashes should be used for preference as they contain potash and phosphate as well as lime.

Proportions of Materials Required.—The above materials will be required in the following proportions:—

Parts by volume.	Materials.	Parts by weight.	Grain bags full per 9 yds length of a standard size heap
420	Mixed vegetable wastes, etc.	400	..
*36 to 18 or less.	Ordinary soil (urinated if available).	*560 to 280 or less	*12 to 6
24	Animal dung	80	8
*3 to 6	Wood ashes.	*6 to 12	*1 to 3
or 1 to 2	Agricultural lime.	*or* 2 to 4	$\frac{1}{3}$ to $\frac{2}{3}$
or $\frac{1}{3}$ to $\frac{2}{3}$	Burnt lime.	*or* 1 to 2	...

*For explanation of variation of proportions see Section II. under "Varying Proportions of Ash and Soil.

It is not necessary to measure the quantities of the various materials for every heap. It is considered that if the quantities are measured for the first few heaps made; thereafter the quantities can be sufficiently accurately judged by eye.

To assist rapid rotting the mixed wastes should consist of at least 25 per cent. of wastes with a high nitrogen content, as specified in the list given in Section II.

Method.—A well drained site should be selected, with a reasonably smooth surface, to avoid water-logging and to make turning easy.

Making the Heaps.—Having assembled all the materials required, the mixed wastes should be made into a heap 16 feet broad and 1½ feet high, and of any convenient length. The heap should be built up in *at least* three layers to ensure even mixing of all the materials at the first turn, as far as possible. *More and thinner layers will assist proper mixing of the materials.* A shallow heap such as this facilitates rapid wetting of the materials with the first rains, and therefore a quick start to the process of rotting, and also makes the first turn easier.

The proper proportion of the soil, dung, and wood ashes or lime are spread evenly over the surface of each layer.

The materials should normally be collected during the dry season, and the heaps should be ready and awaiting the first spring rains.

First Turn.—After the first heavy rains have partly wetted the heap, usually after about 2 to 3 inches of rain have fallen, the heap should be built up into a new heap 9 feet broad at the base by 3 to $3\frac{1}{2}$ feet in height, by throwing the materials with a fork in towards the centre line from either side, and two yards forward at the same time. In doing this mix all the materials thoroughly. *The heap should be left in a loose open condition to assist aeration, and the easy entry of further rain. On no account should the heaps be packed by trampling at any time.*

If the heaps are composed of fine materials such as grass, spoilt hay, maize husks, etc., the rain will not penetrate the heap to a depth of more than about 6 inches, since at this depth a slimy waterproof film is formed by the action of certain microbes.

Second Turn.—In three to four weeks, when the heaps have sunk and packed appreciably, they should be turned to one side or one end, and built up into new heaps of the same dimensions. If rotting has proceeded well, labour may be economised at this and subsequent turns by the use of a dam-scraper, or hay sweep, or similar ox-drawn implement. If rotting is unsatisfactory the use of sharpened "badzas" will help to ease the work.

Manure drag forks, or vine hoes, which are 4 or 5 tined, are of particular value, where very refractory materials such as old matted sunnhemp stalks have to be turned. With these the most obstinate heaps can be torn open; but they will seldom be required after the first turn has been carried out.

Third Turn.—The heaps will require turning again in about a month as before, and will be rebuilt in their original position, and rotting should be complete in a further three weeks to one month. If rotting has not proceeded normally a further one or two turns may be necessary.

The various turnings are done to ensure aeration, and even distribution of moisture or materials, and they should usually be done on a rainy or cloudy day to check evaporation.

unless the heaps are waterlogged. The compost is usually rotted down and ready for use in four months. If it is ready before the end of the rains it is best to delay spreading it on the fields for ploughing under until the seasonal rains have ended, so as to avoid loss, and it should be covered as soon as it is spread for the same reason.

On the other hand, if there is a special reason for using it as early as possible, and providing rotting has proceeded normally, the compost can be applied to the land at the third turn.

Sowing Legumes on the Heaps.—When the wastes being composted are mainly of low nitrogen content, such as old dry grass and maize wastes, or if it is desirable to speed up the rotting process as far as possible, sunnhemp should be broadcast on the surface of the heap after the first turn. The writer has found that the common sunnhemp makes better growth under these conditions than the Somerset variety, and two or three pounds of seed per 100 square yards of surface may be used. It is not necessary to add a surface of soil to enable the sunnhemp to grow, but a thin sprinkling of top soil will help to ensure proper inoculation of its roots.

The sunnhemp will only grow some 6 to 12 inches high before the next turn, but the roots penetrate the heap and the bacteria in the nodules on the roots collect nitrogen from the air. When the sunnhemp is turned under at the next turn this nitrogen promotes rapid rotting, and enriches the compost.

In some cases the writer has seen the sunnhemp being allowed to grow to a height of two or three feet. This is a sign that turning has been unduly delayed, and that the proper heating in the heaps had ceased. It also makes the subsequent turning of the heap very difficult.

Velvet beans are also of value for this purpose, and where compost is being made in winter lupins may be employed.

B. ARTIFICIALLY-WATERED, OR WINTER COMPOST.

When a supply of water is available compost can be made throughout our rain-less winter. It should be made in shallow

pits in order to protect it from the drying winds, and to help maintain the temperature in the heaps.

Size of Pits.

Depth—2 feet—never deeper.

Width—15 feet.

Length—any convenient; but a 60 to 65 feet long pit is suitable, and contains about 25 tons, or 50 cubic yards, of moist ripe compost. The sides and ends of the pits should be cut with a slope at an angle of 45 degrees. (See illustration.)

Filling the Pits.—The same materials and the same proportions of them are required as for rain-watered compost. Fill these into the pits in shallow layers, say, 6 inches deep. The shallower the layers the better will all the materials be mixed at the first turn, and the more rapidly will rotting commence, and the more smoothly and evenly proceed.

Fill the pits to a height of 6 inches above ground level. Leave 8 feet at one end of the pit empty for turning.

Watering.—Each layer may be watered as it is filled in. It should be well wetted, but not drowned in water.

Turning.—As soon as the pit is full, turn the materials, and shake them up, and mix them thoroughly. Sharpened badzas and drag forks will be found useful at this stage. Turn from the end where the empty space has been left, and move the whole heap 8 feet, so that 8 feet of empty space is left again at the opposite end, for the next turn.

Second Turn.—Three weeks later, water the heap and turn again.

Third Turn.—A month later, water and turn again. If necessary a further turn should be given.

A month later empty the pits and stack the compost at the side in heaps 9 feet broad by 4 feet high, to mature for a further month. It can be carted to the fields and ploughed in at this stage if desired.

At each turn after the first the amount of water required is much less than before the first turn, and care should be

Type of pit for making winter or irrigated compost. Sump shown in foreground not necessary.

Winter compost being turned in pit in foreground. Head of ripe compost beyond.

taken not to use too much. The heap should be just moist all through, but not "sopping wet." Excess of water will prevent proper aeration, and rotting may stop in extreme cases.

If there is any urgent need to hasten the process, then the heap can be turned every 10 days or two weeks, and more dung added; or, if this is lacking, sulphate of ammonia may be used at the rate of $\frac{1}{2}$ lb. to 1 lb. per cubic yard of the heap, or bone-meal at the rate of 2-4 lbs. per cubic yard, preferably the latter.

If the pits are watered from a water furrow, care should be taken that they are not near enough to the furrow to become water-logged by seepage from the furrow.

C. KRAAL COMPOST.

The chief item in the cost of making compost from the crop wastes on the farm is the collection and carting of the materials to the composting sites. The means of transport available on Rhodesian farms for this work, that is the ox wagon and Scotch cart, are extremely clumsy, inefficient, and unsuitable for the work. They are also very wasteful of ox-labour for pulling them, and of human labour in filling and emptying them. They are, in addition, very costly. Furthermore, the work of collection and carting of the materials for composting will compete for the use of the wagons with essential work such as the transport of the maize crop to the railway.

For the above reasons it is clearly desirable under local conditions to cut down as far as possible the collection and transport of the crop wastes for composting, and with this in view the following modified technique for treating the large quantities of maize wastes at the shelling dumps, and wheat wastes at the threshing sites, is advised.

Up to date many farmers have been in the habit of destroying this most valuable organic matter by burning. In the case of maize wastes this has been rightly done in the past in order to check the spread of diplodia and allied diseases, and also of weevils, because it is considered by competent authority that they may not be destroyed if converted into kraal manure, owing to the low temperatures which obtain in the manure heap. There is now no excuse for this

criminal waste of the material most urgently required in our Rhodesian soils, namely, organic matter, since these wastes can be converted safely, cheaply, and easily without any artificial water supply, and without the need to use anything that is not to be found on every farm, into first-class humus, by composting them.

Technique.—The modified technique of composting advised for treating maize and wheat wastes at the dump is very simple, and is given below. It is followed by a more detailed explanation of certain points.

(1) Erect a cattle kraal at the shelling or threshing sites.

(2) Place the maize husks and cores, or the wheat and barley straw, in the kraal to the depth of about two feet.

(3) Keep cattle in the kraals until sufficient dung and urine has been dropped by them, and until the depth of trampled wastes in the kraal is about 18 inches. Fill the wastes into the kraal daily as the cattle eat and tramp them down.

(4) Divide the trampled mass in the kraal into heaps 16 feet wide, and over every 9 yards length of the heaps spread one or two bags of wood ash (or a third of this quantity of agricultural lime), and six bags of top soil.

(5) Fork over the heaps well, working from one end and mixing all materials together. Take care to mix the saturated materials from the bottom with those on the top.

(6) After about three inches of rain have fallen in October or November, build the heaps up into new heaps 9 feet wide by 3½ feet high by forking from the sides in towards the centre line.

(7) Turn the heaps once a month, on rainy days if possible (except during heavy continuous rainy spells) until the end of the rains, when the compost should be ripe and ready for carting to the fields and ploughing under.

It will be clear from the above description that the method is extremely simple, and eliminates practically all transport of materials, except the small quantity of wood ash required.

It will be most convenient for the subsequent handling of the compost if the kraal is made 16 feet, 32 feet or some other multiple of 16 feet wide, since the trampled mass of wastes and dung has later to be split up into heaps 16 feet in width.

If the kraals are made with a large enough gate at each end the straw or maize husks can be drawn into the kraal by a hay sweep, and hand labour thereby saved.

It is thought that it will be best to erect a temporary kraal each winter, since after it is filled it can be quickly removed, and will then not interfere with the subsequent work in which hand labour can be saved by using dam scrapers, ploughs, hay sweeps or similar ox-drawn implements for assisting in turning the heaps.

The maize cores should be thinly spread over the surface daily, so that they will be well distributed through the mass. These may not completely rot down in the compost heap, but will become so soft that they will rapidly break down in the soil. Where hand shelling is done it will be best to burn the mouldy cobs, since these will add little bulk to the compost, and their destruction will help to prevent the spread of disease.

The maize stalks and any other handy vegetable wastes from neighbouring fields can be conveniently placed in the kraal in thin layers daily. A generous layer of at least 12 to 18 inches depth should be placed in the kraal to start with, so that the urine may be absorbed and saved from loss as far as possible, since this is a most valuable by-product from the cattle because of its high nitrogen and potash content, because of the hormones it contains.

It is not possible at this stage to state what length of time the cattle must be kept on the wastes. This can only be found out by experience, but it is obviously desirable to discover the minimum so that there shall be no large losses of nitrogen owing to the surplus of dung and urine. Such a surplus of

dung and urine could be profitably employed elsewhere as agents for breaking down additional organic matter to humus. If the latter is not available then there is no objection to keeping the cattle rather longer in the kraal than is strictly necessary, and it will assist in speeding up the rotting of the compost, and the maintenance of a high temperature.

The first turn of the heaps laid down above is designed to prevent the loss of nitrogen through the denitrification which would otherwise take place owing to the compacting of the bottom layer of wastes and dung. Denitrification is brought about by the action of certain types of organisms, which chiefly work in the absence of air, and this condition is brought about by the compacting of a heap by the trampling of the cattle. During the process nitrogen is lost in various gaseous forms: as ammonia, oxides of nitrogen, and nitrogen itself. In this and in all subsequent turns care should be taken to leave the heaps as open and loose as possible, and any compact portions should be broken up with the fork. Always in turning put the outer and less rotted layers inside the heap, and *vice versa*.

At the first turn manure drags or vine hoes will be particularly useful for tearing the heap apart.

Destruction of Weevils and Diseases.—This is particularly important in the case of maize wastes in order that weevils and the spores of diseases such as those of the diplodia group shall be killed by the temperature of the interior of the heap. For the same reasons in treating maize wastes, if necessary, more frequent turns may be given to ensure the development of a high temperature in the heap.

The soil added to the heaps, too, should be taken from the immediate area of the shelling dump, so that weevils in the grain tramped into the surface may also be killed.

In composting maize wastes the heaps should always be in readiness awaiting the commencement of the seasonal rains in October, so that weevils may be killed as soon as possible.

Comparison with Indore Composting.—It will be clear that in the modified technique described above that the quantity of nitrogen supplied in the dung and urine of the cattle cannot

be so well regulated so as to avoid waste as in the normal methods developed at Indore. A certain amount of waste may take place owing to the use of more dung and urine than is necessary and also because some losses of nitrogen by denitrification whilst the cattle are in the kraal will probably take place owing to the compaction of the lower layers of wastes.

However, this will be a matter of less importance where the farmer has insufficient supplies of organic materials (crop wastes, sunnhemp, grass, etc.) for converting into compost. Furthermore, experience will soon teach the farmer to reduce these losses to a minimum by finding the minimum time necessary for keeping the cattle in the kraal.

It will probably be found in practice that the amount of dung and urine supplied by the cattle can be reduced below the minimum necessary for rapid rotting of the compost, without unduly slowing down the process. This will automatically reduce the losses of nitrogen to a minimum and should even lead to appreciable gains of nitrogen from the air, by nitrogen fixation.

One considerable advantage this method will have in this Colony over the ordinary Indore composting is that the urine will be more fully and more economically employed, since urinated soil is not available on most Rhodesian farms in sufficient quantities, and the urine is usually almost entirely lost. This better utilisation of the urine is of considerable importance, since it contains much nitrogen and potash and important hormones.

The greatest advantages claimed for the modification are, however, that both ox labour and human labour are saved, and it is considered that these economies will more than outweigh the possible losses.

SECTION II.—EXPLANATORY.

The process of rotting. What is happening in the heap of compost.

In order to ensure that the composting shall be intelligently managed, and therefore proceed rapidly and economically, it is necessary to know something of what is happening in the heaps during decomposition.

The rotting of the waste materials is carried out chiefly by certain micro-organisms found in the soil. Of these certain fungi commence the process of breaking down the organic material, and the bacteria assist and complete the work. In a properly rotting heap after the first turn the temperature should rise rapidly to somewhere about 130° to 140° F. within a few days, and soon after this the materials should be greyish white in appearance due to the growth of the white fungus mycelium.

An iron rod should be kept handy to the heaps for testing their temperature. If it is thrust into the heap and left to heat for a minute, and then pulled out and tested by hand, it is possible to keep in touch with the process, and a little experience of this test soon indicates when a fresh turn is required. An undue drop in temperature usually indicates that more air is required, and either too little or too much moisture is present.

Both the fungi and bacteria require a proper supply of *water, air* and *nitrogen*, in order to carry on their work; also a sufficiently high temperature, and a neutral or slightly alkaline medium to work in.

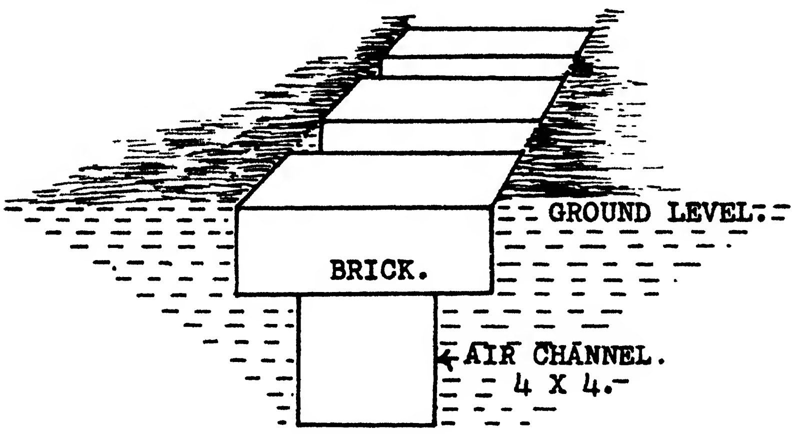
Water.—Sufficient moisture, but not an excess, is required. An excess causes a drop in temperature owing to the slowing up of the process. If at any time the heap becomes water-logged owing to continuous heavy rains, turning it will remove the excess moisture, and assist aeration at the same time. Excess of water tends to exclude air by packing the heap. If the heap become too dry, on the other hand, owing to a continuous drought, it may be spread out again into a heap 16 feet wide at any time, so as to ensure quick and ample wetting by the next rains; and then immediately after the rain it should be built up into a heap of the standard size of 3 to 3½ feet high by 9 feet broad .

Air.—An ample air supply is absolutely necessary in order to supply the oxygen requirements of the micro-organisms. This is regulated by avoiding trampling the heaps when building and turning; by shaking up the materials thoroughly at each turn; by avoiding excess of moisture by giving extra

turns during heavy continuous rains as already mentioned; by avoiding the use of excessive quantities of soil; and by keeping to the standard dimensions of the heap laid down.

The experience of the last two years indicates that extra precautions are required in this Colony to ensure proper aeration of the heap, owing to the packing and temporary water-logging of the heaps during periods of heavy rain. It is, therefore, recommended that whenever possible one or two ventilating channels should be cut in the ground extending the full length of the heap and a yard or two beyond the heap at either end. If two channels are made they should be spaced about three feet apart and they should be made as follows:—

Cut a channel 9 inches wide and 3 inches deep. Down the centre of the floor of this channel cut another one 4 to 5 inches deep, and about 4 inches wide. Old bricks are then laid in and across the upper channel with a space of 3 to 4 inches between them. The bricks serve to keep the lower air channel from becoming blocked. (See figure.)



These ventilation channels greatly assist the aeration of the heap in that part where aeration is most needed, namely, the bottom. The writer strongly recommends that they be used on any site which is regularly employed for compost, and he considers that even on temporary sites the small extra cost and trouble involved will be well repaid by the saving in the labour of turning, and by the better quality of the compost.

Green wastes should be withered before composting, since in the green sappy state they tend to close up the air-spaces in the heap, and so reduce aeration. Proper aeration is necessary not only to ensure the proper progress of rotting, but because in the absence of it large losses of nitrogen may take place owing to the activities of other types of micro-organisms, which attack the nitrogen compounds, and break them down to free nitrogen gas, and gaseous oxides of nitrogen.

Nitrogen.—The micro-organisms require a sufficient supply of nitrogen for building up into their body protein. Part of the organic or combined nitrogen (chiefly in the form of proteins) is given off as ammonia during the rotting process, but this is absorbed by the soil and is converted into the nitrate form by other micro-organisms.

When the rotting process is finished the micro-organisms die, owing to lack of food, and the nitrogen in their cell or body tissue is converted by other bacteria in the soil into soluble nitrate nitrogen, which is directly available to plants.

Therefore during this process there is little or no danger of loss of nitrogen by leaching by the rains until the process of rotting is finished. In fact, when it proceeds properly, and there is no excess of nitrogen in the materials, large gains of nitrogen may be made from the air, by nitrogen fixation by free-living bacteria, and by the agency of the root nodule bacteria of the sunnhemp or other legume grown on the heaps.

In the cattle kraal, however, there are always huge losses of nitrogen to the air in the form of gaseous nitrogen and oxides of nitrogen or ammonia, and by the leaching of the urine, and nitrates by the rain.

Loss of nitrogen will, however, take place if the ripe compost is stored in heaps too long before use. But, this should seldom happen to any great extent in this Colony, since the process fits the seasons so admirably. The process commences with the rains, and should finish with the ending of the rainy season, and if the compost is then spread and ploughed under it is safely banked in the dry soil until the following crop is sown.

The proper supply of nitrogen is regulated by the proportions of dung and urinated soil added to the "mix" and by the proportions of the crop wastes of high or low nitrogen content which are employed. If the normal amount of dung is used then approximately 75 per cent. of the crop wastes may be of low-nitrogen content.

If no dung or other source of extra nitrogen is used then at least one-third of the wastes should be of high nitrogen content.

Below is a list giving the common farm wastes according to the rough classification used above.

High Nitrogen Wastes.	Low Nitrogen Wastes.
(1) *Young* green grass.	(1) Maize rubbish of all kinds.
(2) Soft green weeds.	(2) Old dry grass.
(3) Green sunnhemp, or other legumes.	(3) Spoilt hay and silage.
(4) Legume crop residues and spoilt legume hays.	(4) Stalks of sunflowers, cotton, and sunnhemp after harvesting.
	(5) Cereal straw and chaff.
	(6) Thatching grass.

The farmer will find the analyses of Rhodesian foodstuffs published as Departmental Bulletin No. 1035 of assistance. Any suitable material having a crude protein content of 10 per cent. or more can be placed in the category of high-nitrogen wastes.

If excess of nitrogen is present in the compost heap the process will proceed more rapidly, but loss of nitrogen will take place in the form of ammonia or nitrates, and this is uneconomic. If there is a shortage of nitrogen in the mixture then the process may be slowed down so much that it will not be finished in one rainy season. It may assist the farmer to mix his wastes economically if it is mentioned that one part of green sunnhemp, not more than three months old, with three parts of wheat or barley straw without any other nitrogen supply, makes approximately a perfect mixture of materials for composting without adding any dung. Some soil, and wood ashes or lime, would also be required, of course.

Crop wastes may be composted in normal time without the use of any external source of nitrogen, either in the form of dung or any other material, providing the mixture of materials contains the proper proportion of nitrogen. *The use of some animal dung is always advised*, however, since there is an increasing body of evidence that, besides supplying nitrogen, and stimulating nitrogen-fixation, the use of animal dung leads to the ripe compost containing certain growth-promoting, or stimulating, substances, without which crops do not thrive so well, and are not so resistant to diseases and pests. Some of these have already been isolated and synthesised, and several are now marketed commercially for the purpose of stimulating the root-growth of cuttings. Such substances are known as Hormones.

Other Sources of Nitrogen.—One of the principal virtues of the Indore compost is that no materials except such as are present on any farm, on which oxen are used for traction, are necessary to make it.

Inorganic sources of nitrogen, such as sulphate of ammonia, nitrate of soda, cyanamide, nitrochalk, etc., have been recommended for composting low-nitrogen materials such as wheat straw, without the use of animal dung, by various writers in the local Press and elsewhere, recently, *but the writer strongly deprecates their use, save in exceptional circumstances, since thereby the cost per ton of compost is greatly increased, and this may render the process uneconomical.*

If inorganic sources of nitrogen alone are employed in composting, the cost of a 5 tons per acre dressing may rise to somewhere in the neighbourhood of £4 to £5, where only low-nitrogen material such as wheat straw are composted. The cost of making a 5 ton dressing of rain-watered compost, using only farm sources of nitrogen, should not exceed 10s., and should be appreciably lower under favourable conditions. Compost of high quality has been made in the Colony for less than 1s. per ton.

When organic, combined sources of nitrogen such as are found in animal dung, bone-meal, sunnhemp and other vege-

table materials, are properly employed, there should be no loss of nitrogen up to the completion of the rotting process, but definite gains.

Ayyar* has shown, however, that rapidly available inorganic nitrogenous compounds such as those mentioned above are unsuited to climatic conditions similar to ours, since they cause too rapid a decomposition in the early stages, resulting in loss of nitrogen. In heaps in the open a loss of 26-40 per cent. of nitrogen was observed. The use of slowly available sources of nitrogen such as bone-meal and dung gave even rotting, and reduced the loss of nitrogen to 5 per cent.

Nevertheless, the householder who cannot employ animal dung, or the farmer or market gardener who, for some reason, finds it essential to speed up the composting process, may employ sulphate of ammonia, nitrochalk or cyanamide as their sources of nitrogen. The amount required will vary greatly according to the type of materials to be composted, but as a rough guide it may be mentioned that 68.2 lbs. of sulphate of ammonia are required to rapidly decompose a ton of a material such as wheat straw, or maize husks and stalks, which have a low nitrogen content in the neighbourhood of 0.5 per cent., or a crude protein content of about 3.0 per cent.

Where about one quarter of the mixed wastes are of relatively high nitrogen content one pound to two pounds of sulphate of ammonia per cubic yard of wastes should suffice. *The actual minimum amount required must be found by experience, and if the same mixture of materials is always used this is simplified.* If ammonia is given off freely during rotting then the supply of sulphate of ammonia has probably been too generous, and must be cut down in future. If, on the other hand, too little sulphate of ammonia has been added then the rotting process will be unduly slowed down.

The same proportion of cyanamide as of sulphate of ammonia may be used. About 25 per cent. more nitrochalk must be employed, but since it contains 50 per cent. calcium carbonate, a parallel reduction in the amount of lime used may be made. Calcium cyanamide also contains lime, and in considerably greater proportion than in nitrochalk, since

*Utilisation of Farm Wastes. Agric. Jour., Madras, Vol. 21, p. 335.

it contains a total calcium equivalent of 60 per cent. calcium oxide, or the equivalent of rather more than its own weight of calcium carbonate, or agricultural lime.

To yield about the same weight of nitrogen as 1 to 2 lbs. of sulphate of ammonia, 4½ to 9 lbs. of bone-meal (4.4% N) are required, and these quantities will suffice for one cubic yard of wastes, of which about a quarter have a relatively high nitrogen content.

The use of bone-meal is recommended as an artificial source of nitrogen for composting, *where this is required*, and particularly where the phosphate content of the wastes, as in maize wastes and old dry veld grass, is known to be deficient, and where the price is about £6 per ton.

Recent investigations into the factors controlling the manufacture of compost, which have been carried out at the Imperial College of Tropical Agriculture in Trinidad,* have shown that the use of sulphate of ammonia as a source of extra nitrogen causes a considerable increase in the acidity of the compost heap. This is, of course, undesirable, and it is therefore recommended that it should not be used if the other materials mentioned are obtainable.

Other Requirements of Micro-organisms.—*Phosphates.*—The micro-organisms carrying out the rotting of crop wastes require a certain amount of phosphate to use for building up into their body tissue. With a normal mixture of several types of crop wastes and residues, there will usually be sufficient phosphate for their use.

Where crop wastes such as maize wastes, and old dry veld grass or thatching grass alone, are being composted, there may well be a shortage of phosphates, and the addition of a small quantity of one of the cheap basic phosphates such as rock phosphate may be added with the soil and wood ash. Besides phosphates rock phosphate also contains bases, which are useful in maintaining the reaction of the compost heap near neutrality. The writer has used basic slag at the rate of 1 bag per 50 to 75 cubic yards of heap under such circumstances.

*Experiments on Compost-Making, by R. Cecil Wood. Emp. Jour. of Experimental Agriculture, October, 1938.

Slag also contains bases, which are roughly equivalent in lime value to the same weight of agricultural lime. One bag of slag can thus, besides supplying phosphate, replace an equal quantity of agricultural lime, or three bags of wood ashes, in the compost heap.

Where an external source of nitrogen is also required bone-meal may be used to supply phosphate, since it contains about 4 per cent. of nitrogen in addition to the phosphate, and also lime. Bone-meal contains bases, which are equivalent to about half its weight of agricultural lime.

Bases.—The micro-organisms work most vigorously in a medium which is between neutral and slightly alkaline.

To ensure these conditions basic material such as wood ash, agricultural lime, and burnt lime are added to the compost heap. The wood ash contains a varying proportion of lime according to the amount of leaching by rain it has undergone. The more it has been leached, the higher is the proportion of the lime, since other materials such as the potash are lost. Wood ash in Rhodesia contains about 18 to 50 per cent of lime (CaO). It also contains about 0.4 to 5 per cent. of potash, and the same percentage of phosphoric oxide.

The ordinary loam soils which are approximately neutral, also contain bases, which are useful in maintaining the right reaction of the compost. The ordinary sandy soils are apt to be rather acid in reaction, and the sandy vlei soils are usually very acid. Some of the heavy black vlei soils, on the other hand, may contain a very high proportion of lime, and these would be particularly valuable for use in compost, since they would supply all the lime necessary, as well as the clay, fungi and bacteria.

Varying Proportions of Ash and Soil.—In the tables of proportions of materials given above the proportions of soil, and of lime and wood ash, vary. The reason is that if the amount of soil added is reduced below the maximum, then the proportion of lime or wood ash should be increased in order to adjust the amounts of lime and other bases added to the heap. It is better to err on the side of adding rather more ashes or lime than is necessary, than to add too little.

Soil.—The soil added to the compost heap is required for the following reasons:—

(1) To supply bases such as lime to neutralise acidity and maintain the reaction of the process near neutrality.

(2) To supply clay to form a colloidal film on the surface of the waste materials, which assists the fungi rapidly to commence their action.

(3) To supply the necessary fungi and bacteria.

(4) To temporarily absorb ammonia.

Where the soil is known to be definitely acid, the proportion of wood ash or lime should be increased, and that of the soil reduced to the minimum found by trial to be necessary.

Sandy soils do not supply much clay or basic materials, and it is recommended that never more than 18 parts by volume to 420 parts of wastes should be used, and trials should be conducted with less and less to find the minimum proportion. More lime should be added where sandy soil is employed than where loam soil is used.

Dung Slurry can replace Clay of the Soil.—The lack of clay in sandy soils can be corrected by sprinkling a thing slurry of *fresh dung* stirred up in water. If this is sprinkled over the materials as the heap is being built, a thin film is formed over the surface of the materials, which replaces or reinforces the film normally formed by the clay of the soil. This serves to assist the fungi to commence their work easily and rapidly, by giving them a supply of moisture, and food materials handy for their immediate use.

In the same way when the proportion of loam soil is reduced to the minimum, the lack of clay may be made good by the use of dung slurry.

Use of Dung Slurry always worth while.—The use of the dung slurry when building compost heaps can always be recommended, since it is extremely effective in ensuring a quick start of the rotting, and also, more important still, even rotting throughout the heap.

The little extra trouble caused by using it is far outweighed by the big saving of labour obtained by reducing the quantity of soil in the mixture to the minimum. When the normal amount of soil recommended for the Indore process is used (36 parts by volume in the above table of proportions) the soil represents a large proportion of the finished compost, and a considerable proportion of the labour employed is required for the collection and spreading of the soil, and later in riding and carting the ripe compost.

Reducing the Soil Increases Humus Content.—It must be borne in mind that such a reduction in the proportion of soil used will be followed by a proportionate increase in the proportion of humus in the ripe compost, and therefore of its manurial value.

The rate of application per acre can therefore be reduced. As a rough guide it may be stated that if a reduction in the soil be made from 36 parts to 18 parts by volume in the mixture recommended in Section I., then a 5 to 6 tons per acre dressing will be roughly equivalent to an 8 tons dressing with the full 36 parts of soil. The economy made in the labour of carting and spreading the compost will be obvious from the above figures.

Excess of Soil.—The use of any excess of soil beyond the recommended maximum is very inadvisable, since not only will it have the disadvantages outlined above, but it will cause the heaps to pack more, and air will be excluded; and loss of nitrogen will take place by the action of anaerobic bacteria in breaking down the nitrogen compounds to the gaseous forms, ammonia and free nitrogen.

Use of Minimum Quantity of Soil.—For these reasons farmers are advised to reduce the proportion of soil, especially sandy soil, gradually until they find the minimum required, and replace the clay and basic material in it, by the use of the dung slurry, and increased amounts of ashes or lime.

To be economic it is essential that the cost of making compost shall be reduced as far as possible, and this is one way of doing this.

The writer has found that, where the soil is a red or chocolate loam, half the maximum proportion laid down will suffice to ensure good breakdown of almost mature sunnhemp and old grass. The finished compost contained 5.3% more organic matter (loss on ignition) than that made with the full quantity of soil.

Cross-inoculation from Older Heaps.—Another means of speeding up rotting, and ensuring even rotting, is by inoculation of a heap at the first turn, by sprinkling a small quantity of the material from an actively rotting heap about 10 days old over the heap as it is turned. The material taken should be white with the fungous growth.

When making the dung slurry, this fungous material can be mixed with it, together with some of the wood ashes or lime, to make a thin slurry, which is then sprinkled lightly over the materials as they are turned. Only a very light sprinkling is required.

In the same way at the second turn, a small amount of compost from an actively rotting heap about 30 days old may be lightly sprinkled over the materials as they are turned. This inoculates the heap with active bacteria.

When starting compost making, small "pilot" heaps can be made and watered artificially to provide the requisite material for these inoculations. In making winter compost these cross inoculations are particularly valuable, since they can be carried on from one heap to another successively, and this is found to increase very greatly the virulence or activity of the strains of fungus and bacteria.

Cracking Hard Materials.—Hard materials such as whole maize stalks, cotton stalks, tobacco stems and roots, and sunflower stalks, are not easily attacked by the fungi, as they are protected by the hard woody "bark" or outer covering.

If these are included in the compost heap and it is desired to complete the rotting within the four months of the wet season, then they should be cracked or crushed, either by placing them in a cattle kraal for a week or two, or by placing them on a track or road freely used by farm traffic, or by running a heavy roller or culti-packer over them.

Where such materials form a large proportion of a compost heap there is a greater need to use dung slurry, and the full amount of soil, than for a normal mixture of materials.

Where sunnhemp is composted on the land it is strongly recommended that all such hard materials be mixed with the sunnhemp in the temporary kraals. This solves the problem very simply, and the time and cost of carting will be repaid by rapid rotting, and a reduction in the labour of turning the heaps at the first turn.

Combined Use of Compost and Phosphatic Fertilisers.—Compost made by the methods described contains only a small percentage of phosphate, and it should be used in conjunction with dressings of phosphatic fertilisers. In this way the best results from both the compost and the fertiliser will be obtained. Particularly in acid soils the humus of the compost is extremely valuable in tending to prevent the fixing or immobilising of the added phosphates by the soil in a form unavailable to crops, by their combination with aluminium or iron. Thus the humus increases the availability of the phosphates added to an acid soil. It is possible that a reduction in the normal rate of application of phosphatic fertilisers may be possible where compost is used, but each must test this carefully for himself, and no general recommendation can be made.

Many farmers have asked the writer whether the separate spreading of the phosphatic fertilisers cannot be avoided by mixing the latter with the compost in the heaps. This can be done, of course, but if the farmer wishes to apply a definite amount of phosphatic fertiliser per acre, a carefully taken composite sample of the finished compost will have to be analysed, if he is to know just how much phosphate he is adding per acre.

The writer cannot recommend this method of applying the phosphates with the compost, since he is of the opinion that the farmer will have difficulty in regulating the exact application of the phosphatic fertilisers at the rates found most profitable by experience.

Compost and the Common Crop Diseases and Pests.—Since the compost is made from crop residues the question of whether diseases and pests can be carried over from year to year through the compost is one of some importance, particularly to the maize grower, who is composting maize residues, since the question of the control of the diplodia group of diseases is of some moment.

An enquiry was addressed on this matter to the Director of the Imperial Mycological Institute and his reply is given below:—

"Replying to your letter of the 20th March, I believe that there would be very slight, and probably no risk, of spreading the maize diseases caused by *Diplodia zeae* and *Gibberella saubinetii* by adopting the Indore method of composting the stalks, trash, and mouldy cobs, provided the material is suitably prepared and the method properly carried out. The optimum temperature for the germination of the spores of the mycelial growth of *Diplodia zeae* lies between 80° and 86° F. and the maximum between 95° and 104°; a temperature 10° higher than the maximum if maintained for a relatively short period under the conditions of aeration and humidity of the fermenting mass would destroy that fungus and other pathogenic fungi. In a normal fermentation the temperature during the first few weeks may rise to about 150° F. and be maintained near that for a considerable time; such a temperature under the moist conditions of the fermentation must be rapidly destructive to the pathogenic fungi."

It would appear, therefore, that where compost is properly made there is little or no risk of the spread of these diseases by its use. The same cannot be said of kraal manure, since high temperatures are not maintained throughout the manure for any time, and the possibility of danger in this regard must be borne in mind.

Tobacco Diseases.—Since it is known that some of the tobacco "spot" diseases will withstand the temperature of flue curing without being killed, it seems clear that there is danger in the use of the tobacco crop residues, such as primed leaf, old stalks and scrap, in compost which is to be applied direct to the tobacco crop.

If, however, the compost in which these minerals are incorporated, are applied to the crop (other than tobacco) preceding tobacco, there should be no danger of fostering the various diseases of this crop by the use of compost, and there is evidence that the proper use of organic manure renders the tobacco crop more resistant to disease.

Compost made from other materials, excluding tobacco wastes, can be safely applied to tobacco.

Pests.—The common maize pests, such as the stalk borer, ear worm and weevil, will not be able to live in properly made compost.

Eelworm, also, will not live through the composting process.

To sum up the position briefly, it is considered that the only danger of spreading plant pests and diseases by the use of properly made compost, is in the case of the tobacco crop as already mentioned.

(To be concluded.)

Deeds, not weeds, should be your goal.
Cleanliness aids insect control.

Fumigation with Hydrocyanic Acid Gas

By M. C. Mossop, M.Sc.

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FUMIGATION.

Fumigation with hydrocyanic acid gas, more commonly known as "cyanide fumigation," has long been established as a standard means of treating various plants, foodstuffs, and other products, and also buildings, to kill insects. Fumigation comprises the exposure of the subject to gas of a lethal concentration in an enclosed space.

THE GAS AND MATERIALS PRODUCING IT.

Hydrocyanic acid (HCN), commonly known as prussic acid, at normal pressure is a gas when above 79° F. and a liquid below this temperature. The liquid is colourless and volatile. The gas is extremely poisonous, invisible, lighter than air, and non-inflammable at ordinary fumigating concentrations. It has a smell resembling that of bitter almonds —or to the fumigator the odour of almonds is reminiscent of HCN.

Various materials are purchaseable for the production of the gas. The containers always hold a large or small quantity of HCN in the gaseous form, and care should be taken not to breathe any of this when a container is opened. The materials generally used for fumigating with HCN are described below.

SODIUM CYANIDE, SULPHURIC ACID, AND WATER.

Sodium cyanide is a white solid procurable in half-ounce lumps and is very poisonous. It is hygroscopic, *i.e.*, it absorbs moisture from the air, and should be kept in air-tight containers. Sulphuric acid is a heavy liquid which is poisonous and capable of inflicting severe burns and destroying clothing and many other articles. It should be kept well stoppered to prevent it absorbing moisture from the atmosphere and overflowing. Hydrocyanic acid gas is produced by violent reaction when the cyanide is added to acid diluted with water.

LIQUID HYDROCYANIC ACID.

This is merely the liquified form of HCN and is obtainable under pressure in steel cylinders holding 75 lbs. It normally

boils at 79° F., and should therefore be kept in a cool place. At Rhodesian altitudes the boiling point when the liquid is exposed would be nearer 75° F. Liquid HCN is usually applied by spraying it into the enclosed atmosphere.

HCN AND DICTOMACEOUS EARTH, *e.g.*, "ZYKLON."

In the preparation of "Zyklon" the diatomaceous earth (Kieselguhr) in granular form is made to absorb a known quantity of liquid HCN, and a little tear gas is added as a warning. It is then packed in strong tins and sealed. "Zyklon" should be stored where the tins will not rust, and preferably in a cool place. The gas is released when the tins are opened and the contents scattered on the floor.

CALCIUM CYANIDE.

This is the chemical, $Ca(CN)_2$, and is supplied in air-tight tins as powder, granules, flakes, or briquettes. On combination with atmospheric moisture it gives off HCN and leaves a residue of lime. Calcium cyanide should be stored in a dry place. It is applied by scattering on the floor or forcing through a special blower.

THE ENCLOSED SPACE.

Fumigation may be carried out in a specially constructed fumigation chamber, a sealed room, house, or warehouse, an animal burrow, the space enclosed by a canvas fumigation sheet placed over a tree or other object, or in the soil. The enclosed space should be air-tight and preferably fitted with an oscillating fan or other device for circulating the air.

THE FUMIGATION CHAMBER.

Where fumigation of movable products or plants is to be carried out as a routine, a specially constructed chamber is by far the most suitable type of enclosure for the purpose. It should be situated in the open, well removed from other buildings. Preferably, it should be constructed of plastered brick, concrete, or metal, with a hard and dry floor and with a concrete roof, or with other types of roof over a gas-tight ceiling. Other construction materials are satisfactory if they are not liable to warp or shrink, and if they can be painted

over when necessary to prevent the escape or absorption of gas. Except under justifying circumstances, such as provision for gas distribution, no one internal dimension should be more than twice any other.

The chamber should be fitted with a wide door on one side and a ventilating window opposite. Door and window should be gas-tight when closed, should open outwards, and should be openable from the outside. Suitable hinges, clamps, and padding should be fitted. Refrigerator-door fittings will be found to be satisfactory. As fumigation of living plants should not be carried out in a strong light, the window should either be of opaque material or be fitted with a blind. Glass is preferable, as it can be broken from inside to open the window if an accident should render such action necessary.

All absorbent surfaces, including walls, ceiling or roof, and floor, should be well coated with paint, tar, or other substance impervious to gas.

In special circumstances, vacuum fumigation chambers are used, but these need not be discussed here.

THE SEALED ROOM OR WAREHOUSE.

For fumigating products on rare occasions in a room, or for fumigating against pests that have become established in a room, house or warehouse, the structure can be converted into a temporary fumigation chamber. Even a portion of a room can be partitioned off with suitable material for making a small temporary chamber, but this entails added dangers, and is seldom convenient, except when carried out by a professional fumigator who keeps a stock of suitable materials on hand especially for the purpose.

For effective fumigation the preparation of a room, house or warehouse must be thorough. All cracks and openings must be sealed—as many as possible from the outside. Sealing from the outside is especially necessary when the structure is being fumigated against pests that have become established in it, for such pests are apt to hide in cracks and crevices. If these are sealed from the inside, the insects are protected from exposure to the gas and are not killed. Outside sealing is necessary for the doors and windows also, as these are to be opened from the outside for ventilation after fumigation.

Convenient, though not necessarily the best materials, for sealing are:—(1) Strips of paper for pasting over cracks at doors, windows, overlaps of corrugated iron roofing sheets, and any similar slits. If the paper is thin, more than one layer should be used.. Thick paper can be used if the strips are softened in water before being pasted on. (2) Mud or a pulp made of soaked newspapers for stuffing up holes where corrugated iron roofs rest on walls, or for other holes of a similar size. (3) Sheets of thick paper for pasting over larger openings such as ventilators, unglazed windows, etc.

All sealing should be completed before fumigating is commenced, except the sealing of the door that is to be used as an exit by the operator or operators. The material necessary for sealing this door should be prepared beforehand so as to be ready for application as soon as the door is closed.

THE ANIMAL BURROW.

Holes made by rodents or other animals may be fumigated in order to kill their occupants. Such fumigation may not always be satisfactory, as the extent of the tunnels is not known and some animals, such as spring hares, close off a portion of the burrow. Possible exits should be blocked up, leaving one or more for the introduction of the fumigant. The number left open will depend on the kind of burrow and the operator's experience. A convenient medium for blocking up holes is mud, or, if the hole is large, stones or sacking or grass, plus mud.

THE FUMIGATION SHEET.

The principal use of the fumigation sheet or tent is for the fumigation of citrus trees against scale or other insects. These tents are usually marked off in figures, and in conjunction with a tape measure when the tree has been covered, certain dimensions are taken and the amount of the charge of poison determined by reference to a chart. It is not proposed to go further into the subject here, as it was dealt with exhaustively by Dr. Bernard Smit as recently as 1937 in Bulletin No. 171 of the Department of Agriculture and Forestry, Pretoria, Union of South Africa. His bulletin is entitled "The Cyanide Fumigation of Citrus Trees in the

Eastern Cape Province, South Africa," and English and Afrikaans copies may be obtained from the Government Printer, Pretoria, at threepence each.

The fumigation sheet is also used for the treatment of bagged grain. However, carbon bisulphide, although it has the added danger of being inflammable and explosive, is superior to HCN as a fumigant for grain. A detailed description of the use of the sheet for this purpose does not therefore fall within the scope of this paper.

THE SOIL.

Fumigation of the soil with HCN is sometimes carried out in order to kill subterranean pests such as eelworm or root-gallworm, and various insects. As it hardly falls within the limits of economic agriculture in Rhodesia at present, details need not be included here. The cost would probably be about £30 to £70 more per acre for materials alone, depending on the degree of control required.

THE ARRANGEMENT OF ARTICLES FOR FUMIGATION.

In order to obtain the optimum diffusion of gas through articles to be fumigated, it is not enough merely to dump the articles on the floor. Bundles of plants should be opened up and placed on open strip or wire netting shelves. Bales or bags of produce should stand apart from each other on dunnage and away from the walls. If it should be necessary to stack them in more than one layer, dunnage should be placed between the layers. Bales of tobacco should be well separated with their stem-end faces exposed to the best advantage, and their paper wrapping should be removed or else well loosened all round. The bottoms of the bales can be separated from the paper by interposing piping or strips of wood.

When preparing to fumigate infested rooms, etc., the operator should make sure that all water and moist foods are removed. Water absorbs HCN gas and, besides reducing the amount of gas available against pests, it becomes poisoned. The removal of dry foodstuffs, such as meal, is advisable, but

less necessary. Although it absorbs some gas, the latter disappears if the foodstuff is exposed to the air.

Warehouse refuse should be cleaned up and burned before fumigation commences, care being taken not to distribute insect pests outside the building when the refuse is being removed. All machinery and furniture should be opened up to allow entry of the gas.

PLACING THE CHARGE.

When all is ready, the quantity of materials required for the production of the desired amount of gas should be placed or released as described below, and the room vacated in *deliberate and orderly haste.* If more than one or two gas-producing units are to be used there should be more than one operator—if more than about four units, gas masks should be used or other suitable precautions taken. If gas masks are available, as they should be, they should be used or kept handy for all fumigations. The writer, when fumigating, attempts to create an impression of quiet and controlled efficiency, all actions being carried out with reasonable rapidity, but with deliberate precision. This is done partly to remind himself of the danger present, and partly to inspire confidence in others.

The method used in employing the different sources of HCN gas are described below. The choice of materials will depend upon the nature and frequency of the work to be performed. A later section entitled "Precautions" should be studied before each fumigation is commenced.

SODIUM CYANIDE, SULPHURIC ACID, AND WATER.

Fumigation with HCN produced by the reaction when sodium cyanide is added to dilute sulphuric acid is often known as the "Pot Method" of fumigation, as the reaction is made to take place in a special earthenware pot or similar container. Sodium cyanide of 97-98% purity is advised for use in fumigating by this method. The product normally obtainable in Rhodesia comes well within this standard. Sodium cyanide is sometimes referred to as 129-130% cyanide. This really refers to the amount of cyanide it contains as compared with potassium cyanide which was used before the

general adoption of sodium cyanide. Commercial concentrated sulphuric acid is of satisfactory quality, and it is therefore wasteful to use the chemically pure acid. Considerable heat is generated during the reaction, which is of a fairly violent nature. The reaction is expressed by the chemical equation: $2NaCN + H_2SO_4 = 2HCN + Na_2SO_4$.

The quantity of chemicals to use varies with the circumstances, but the chemicals should be used in the following *proportions* and always in the following *order*, unless special apparatus designed for their use in a different order is being used:—

Water	2 fl. oz.
Commercial sulphuric acid ...	$1\frac{1}{4}$ fl. oz.
Sodium cyanide	1 oz.

Equipment and Procedure.

Vessels for generating HCN gas should be of a substance that will withstand sulphuric acid and heat. Earthenware or heat-resisting glass pudding basins, glazed crocks, washstand chinaware, wooden bowls or barrels, or cast iron drums are useful. Their capacity should not be less than one quart for every two ounces of sodium cyanide to be used, otherwise the liquid is liable to boil over and become ineffective, besides damaging the floor. A fifty-gallon water-tight wooden barrel is very useful for generating gas from 15 to 35 lbs. of sodium cyanide. An average toilet set water jug will do for about 8 ounces. The vessel should have a wide mouth to reduce the chances of the liquid boiling over, and, for smaller doses especially, a narrow bottom helps to ensure that the cyanide is covered by the dilute acid. If desired, a loosely fitting fluted lid can be used to prevent acid-splash, although this is seldom necessary, except in tent fumigation or where chambers are so fully packed that the generating vessel must be placed near to damageable articles.

Other equipment required consists of a glass measure for water and acid, and scales for weighing the cyanide. As sodium cyanide can be purchased in lumps averaging half an ounce each in weight, scales are not necessary when more than several ounces are being used, as the weight can be obtained by counting the lumps. For fumigation involving

several pounds of cyanide, however, counting becomes tedious and scales are more convenient. When quantities are small the cyanide usually needs to be weighed, for a small error might have serious effects if living plants are to be fumigated.

Sodium cyanide should be used in lumps small enough to be covered by the amount of dilute acid necessary for the reaction. When small quantities are being used, half-ounce lumps need to be broken. When larger quantities are being used and half-ounce lumps are not available, large lumps should be broken. They should not be broken down too finely, however, otherwise the reaction will be too violent. When lumps are being broken, care should be taken that no chips fly up into the mouth or eyes. All chips that fly out should be collected to prevent their being picked up by poultry, pets, etc.

The procedure in starting the reaction is as follows:—First, the water is measured and poured into the generating vessel. Next, the acid is measured and poured *slowly* into the water. This causes spattering, heating of the mixture, and frequently even boiling. If there are more than a few ounces to mix, the liquid in the vessel should be stirred with a wooden stirrer while the acid is being poured. Boiling and bubbling up into the operator's face or elsewhere on his person or clothing can thus be avoided. Last, a final look round should be taken to confirm that all is ready and that no unauthorised persons or animals are present, and, while the operator holds his breath, the cyanide should be slide or lowered carefully into the vessel and the room vacated. The reaction takes the form of violent effervescence immediately the cyanide comes into contact with the acid. The door should be locked and sealed at once.

As HCN is lighter than air, the generating vessel should stand on the floor, or where damage to the floor is to be safeguarded against the vessel can be placed on sand or in a shallow bath. Damage to floors may be due to splashing over, boiling over, or the conduction of heat through the vessel.

A convenient method of adding up to a few ounces of sodium cyanide to the dilute acid is by sliding it into the vessel from a piece of stiff paper that has been folded down the middle and opened up again, thus forming a channel or

chute to direct the cyanide into the vessel. A piece of sheet tin bent down its middle line will do for larger doses. If, however, there is more than one vessel to be charged, the cyanide can be put into paper bags and each bag placed on the floor beside the vessel into which it is to be lowered. The operators then start at the portion of the building farthest from the exit and work their way towards the exit, lowering each bag into its vessel as they go, and always keeping each other in sight. The acid eats its way through the paper before attacking the cyanide, thus delaying the discharge of gas for a short while. Although a small leak in the bag will allow a little gas to be evolved almost at once, the immediate violent reaction is avoided.

If a longer delay is desired, two bags may be used instead of one. The cyanide is placed in the first bag, which is then closed, wrapped, tied, and placed in the second bag. As sodium cyanide is somewhat hygroscopic and becomes wet on exposure to moist air, it should not be weighed and placed in paper bags until it is needed. If this is done too early the lumps are liable to absorb water from the air and wet the bag, thus weakening it and possibly causing it to break when it is being lowered into the acid. Such a break may lead to the immediate evolution of gas and drive operators without gas masks from the room when perhaps only half the vessels have been charged. If the units are large it is advisable to make a practice of wrapping the cyanide in paper and then in hessian or similar cloth in order to avoid the effects of breakage of the paper.

Whether paper bags are used or not, it is safer to use gas masks, provided they fit properly and are in good condition. (See section under heading "Gas Masks.")

Another method where several units are in use is an arrangement of strings to lower or drop the cyanide, whether in bags or otherwise, into the dilute acid. Details can be worked out by the operator according to the nature of the building and the materials available, but in any case several trials should be made before the charge is finally set.

Special designs of apparatus for generating HCN gas from sodium cyanide and dilute sulphuric acid, and leading

it into tents, rooms, etc., are available but are rather expensive unless in use as a frequently repeated routine.

LIQUID HYDROCYANIC ACID.

As stated before, liquid HCN, or "liquid cyanide," is obtained in steel cylinders. When full these weigh about 275 lbs. each and contain 75 lbs. of HCN. In the past there have been certain difficulties in transport and storage of liquid cyanide, but some of these have now been overcome. Facilities for the use of the liquid for occasional small fumigations in Southern Rhodesia are not yet satisfactory, but for orchard work or large-scale or frequent fumigation the methods available are simple and up-to-date. Details are given by the African Explosives and Industries, Ltd., in their booklet "Liquid HCN for Citrus Fumigation," a copy of which any one considering the use of this liquid should obtain.

Equipment and Procedure.

A special portable applicator is used in conjunction with cylinders of liquid cyanide. For fumigating citrus trees or for other work involving numerous small dosages this apparatus simplifies the work very considerably. It consists of a reservoir for the liquid, to which is attached a hand-operated measuring pump connected with a delivery pipe and nozzle. The dose to be given is measured by the number of strokes made with the pump. The liquid is sprayed into the enclosed space through the nozzle and evaporates rapidly.

Liquid HCN needs to be stored in a cool place and in hot weather it should be cooled before cylinders are opened. As it is liable to deteriorate, no more than is required for a few months should be purchased at one time.

HYDROCYANIC ACID AND DIATOMACEOUS EARTH.

The only substance of this kind known by the writer to be obtainable locally is "Zyklon," of which the nature has already been explained. Mere exposure of this substance to the atmosphere by scattering the granules on the ground or floor results in the evaporation of gas. The small admixture of tear gas acts as a deterrent to people entering before ventilation is complete. "Zyklon" is very convenient for most types of fumigation, but for occasional small-scale work

it has the disadvantage that it is packed in tins containing 4, 8, 12, 16 and 40 ounces of HCN, and therefore for the fumigation of a room calling for six ounces, either a 4 oz. tin must be used with a longer exposure, which is often inconvenient or unsatisfactory, or an 8 oz. tin must be used. For large numbers of constantly repeated doses of fixed quantity, the makers may be prepared to vary their present practice.

Those who prefer to fumigate with "Zyklon" should study the subject in the latest booklet that may be obtained from the suppliers, namely, The South African Fumigation Co. (Pty.) Ltd., Durban. whose local wholesale distributors are Messrs. Harrison & Hughson, Ltd., Salisbury and Bulawayo.

Equipment and Procedure.

As "Zyklon" has to be scattered after the release of HCN gas has commenced, the use of a gas mask is especially desirable, particularly when larger tins are being used. Gas masks are essential if more than two tins are required, unless some special arrangement can be made for spreading the charged pellets of which "Zyklon" consists.

A suggestion for such an arrangement might prove of value in connection with the use of "Zyklon" in fumigating chambers. This would involve the fitting of one or more trap-doors in the roof, a tin cone to be fitted under each trap-door. The pellets can then be poured over the cone and these become distributed while the operator is in the open air. The trap-door can then be closed while the next tin of "Zyklon" is being opened. If the gas concentration required is heavy, concentric cones can be fitted, the outer one being cut off at the top so that some of the pellets will go through to the inner cone. The outer cone should be larger and constructed with a greater spreading capacity. Care should be exercised not to breathe the gas that might escape when the trap-door is opened to admit a second or subsequent tin of "Zyklon."

For the straightforward fumigation of a room with one tin of "Zyklon," first prepare the room and contents as previously described. Next, in the open air, pierce the lid of the tin with a sharp heel of an axe or chopper to allow

the free gas under pressure to escape. Then with a hard blow of the chopper, make a deep gash in the lid and twist the blade to enlarge the opening. All this should be done in the open air with one's back or side to the wind. The escaping gas must not be breathed into the lungs. (Escape of gas can to a large extent be prevented by exposing the unopened tin to low temperature for an hour or more. Most of the HCN will then be in the liquid form, absorbed by the pellets of earth.) The opened tin should now be carried into the room, the contents scattered over the floor, the room vacated, and the door immediately locked and sealed. Two tins may be handled in the same way, provided they are carried into the room and emptied together. Where gas masks are being worn by operators familiar with their use and abuse, the tins may be opened inside the room.

CALCIUM CYANIDE.

Whether in the form of dust, flakes, granules, or briquettes, calcium cyanide relies on atmospheric moisture for the liberation of HCN gas. The reaction occurs according to the chemical equation: $Ca(CN)_2 + H_2O = 2HCN + CaO$. (The CaO, or quicklime, rapidly combines with more atmospheric moisture to form slaked lime, which in turn takes up atmospheric carbon dioxide becoming carbonate of lime.) If the moisture present is not sufficient for the reaction, it can be added to the atmosphere of the enclosed space by the atomisation of water through a fly-spray gun. Unlike the preceding fumigant, calcium cyanide is easily divided into smaller quantities than supplied in a container. If the container is then properly closed the fumigant remaining in it will keep.

Calcium cyanide is supplied in two main chemical forms, one generating about half as much HCN as the other. The first is represented by "Cyanogas," usually procurable in the granular or in the powdered form. The other is represented by the "Calcid" products, usually sold as briquettes but also made in other forms. Trade literature on "Cyanogas" is

obtainable from Messrs. Fraser & Chalmers, Salisbury and Bulawayo, and on "Calcid" products from Messrs. Harrison & Hughson, Salisbury and Bulawayo.

Equipment and Procedure.

Granules, powder, or flakes, are simply scattered thinly on the floor of the enclosed space, no equipment being required. The gas comes off fairly quickly, but in small-scale fumigation the dose can be applied with comparative safety without a mask if one works speedily and does not inhale the gas. If the floor is wet, as may happen in a green-house, the water should be mopped up and the material sprinkled on sheets of paper.

The powder form is well adapted for forcing into rodent burrows and similar tunnels by means of a special pump. The distribution of gas obtained by this method is far superior to that obtained by merely throwing in the fumigant at the entrance. The moisture in the burrows is practically always sufficient for the evolution of HCN.

The briquette form needs to be powdered before application, and different sized grinding and blowing machines are made for the purpose. As each briquette evolves a known quantity of gas, measuring is accomplished by counting the briquettes. This is of advantage, especially when large numbers of small doses are to be applied, such as in citrus fumigation.

MEASUREMENT OF THE ENCLOSED SPACE.

Before working out the dosage, one needs to know the cubic contents of the enclosed space, as dosages are calculated on the amount of gas necessary for 1,000 cubic feet.

For a square or rectangular room with horizontal floor and ceiling, simply multply length by breadth by height, all in feet, and the resulting figure will be the number of cubic feet enclosed.

For a room with a lean-to roof as shown in cross-section in Fig. 1, *b*, add the number of square feet in the rectangle

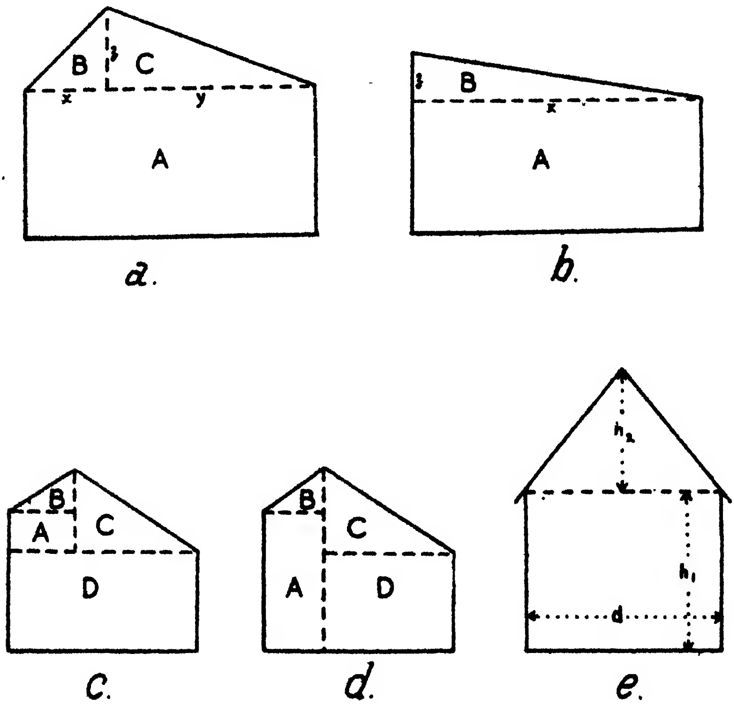

Fig. 1.—Cross sections of rooms having: *a* Ridged roof and opposite walls of equal height; *b* Lean-to roof; *c* and *d* Ridged roof and walls of unequal height; *e* Conical roof and circular wall.

A to the number of square feet in the triangle B, and multiply the result by the length of the room in feet. (The area of triangle B is $\frac{x}{2} \times z$).

For a room with a ridged roof and side walls of equal height as in Fig. 1, *a*, add the number of square feet in the rectangle A to the number of square feet in the triangles B and C, and multiply the result by the length of the room in feet. (The areas of triangles B and C respectively are $\frac{x}{2} \times z$ and $\frac{y}{2} \times z$, or the sum of their areas is $\frac{x + y}{2} \times z$. If the roof has an even span, the two triangles will have equal areas.)

For a room with a ridged roof and side walls of different heights, add the number of square feet in the rectangles and triangles A, B, C and D, as in Fig. 1 *c* or *d*, and multiply by the length of the room in feet.

For a circular room with a conical roof such as a rondavel or Kaytor hut as in Fig 1, *e*, where d=diameter, h_1=height of wall, and h_2=the difference between the vertical height from floor to apex and the height of wall, use the formula $\frac{11 \times d \times d \times (h_1 + \frac{1}{3} h_2)}{14}$ which is a modified combination of the well known formulae: *pi* r^2 *h* and $\frac{1}{3}$ *pi* r^2 *h*.

If the roof is of thatch it should be covered by overlapping tarpaulins tied tightly under the eaves, and an arbitrary 20% should be added to the dosage to allow for penetration into and absorption by the thatch, and for the extra space occupied by it. For instance, to arrive at a figure for a thatched rondavel 10 feet in diameter with walls 8 feet high and with a vertical distance of 14 feet from the floor to the apex, the above formula should be used, giving:

$$\frac{11 \times 10 \times 10 \times (8 + \frac{1}{3} \text{ of } 6)}{14} \text{ cubic feet.}$$

$$= \frac{11 \times 100 \times 10}{14} \text{ cubic feet.}$$

$$= 786 \text{ cubic feet.}$$

Add 20% allowance for thatch = 786 + 157 = 943, or for practical fumigation purposes, a round figure of 1,000 cubic feet.

For a circular room or receptacle with a flat roof, such as a silo, tank, or drum, use the formula,

$$\frac{11 \times \text{diameter} \times \text{diameter} \times \text{height.}}{14}$$

which is derived from the formula, *pi* r^2 *h*

(*To be concluded.*)

Use of Locust Bait.

SOME AMENDMENTS TO PREVIOUS SUGGESTIONS.

In view of later experience, the following amendments can now be made to the suggestions in an article, " A Poison Bait for Young Locust Hoppers," published in the February number of *The Rhodesia Agricultural Journal* of last year, and reprinted as Bulletin No. 1059 of the Department of Agriculture :—

1. The poison to be added to 98 lbs. of maize meal remains the same, namely, two pounds of *fine* arsenite of soda. Approximately the same proportions are obtained when using a 1 lb. coffee tin filled with poison for every bag of maize meal.

2. The amount of water to be added to 100 lbs. of dry bait should be increased to 12 or more gallons. This amount of water tends to cause lumps to form in the bait and these should be broken up by hand. Lumps are extremely dangerous and are a waste of bait, but it must be borne in mind that even without lumps the bait is dangerous to stock and vegetation. Squeezing bait in the hand as a test for moisture is not satisfactory when maize meal is being used as the carrier, but applies to fine bran.

(In the bait now obtainable in the Union of South Africa water is added to the extent of two to three times the weight of the dry bait.)

3. The seed-sowing method of spreading the bait has not been found satisfactory under Rhodesian conditions. A straight-arm, *forceful*, forward side-swing releasing a small handful of bait is much more effective. As much bait as possible must be made to stick to the plants, that which falls on the ground not being very effective against Red Locust hoppers.

4. Emphasis should be placed on the instruction to bait the foliage around a swarm as well as that on which the swarm may be feeding or resting. When the swarm is densely crowded this is even more important, and a larger surrounding area should be baited.

5. The baiting of a swarm as soon as it commences to hatch is not always desirable, except, possibly, in lands where the hoppers can be easily seen. Early baiting is preferable for large swarms, but small swarms may be left for a day or two until they begin to eat freely.

Rhodesia Weather Bureau.

JANUARY, 1939.

Pressure.—Mean barometric pressure was generally about 0.5 millibars above normal.

Temperature.—Mean maximum temperatures were from 1—2° below normal in most places and mean minimum temperatures were about normal.

Humidity in terms of dew-point was about normal.

Rainfall and Weather.—The country was covered by equatorial air during the first fortnight and in the absence of major pressure movements the weather was of the thunderstorm type. An invasion of air from the South Indian Ocean took place during the third week of the month and comparatively fair weather was experienced from the 16th—24th. This air was replaced by air of equatorial origin on the 24th and thunderstorms continued to the end of the month.

Station.	Inches.	Normal.	No. of Days.
Beitbridge	2.27	3.21	4
Bindura	9.97	7.39	23
Bulawayo	4.92	5.61	10
Chipinga	6.98	10.38	19
Enkeldoorn	5.01	7.63	13
Fort Victoria	2.78	6.14	14
Gwaai Siding	8.51	5.41	17
Gwanda	2.58	5.53	5
Gwelo	3.84	5.99	18
Hartley	4.68	7.74	20
Inyanga	8.22	9.92	22
Marandellas	9.78	8.56	20
Miami	10.75	8.25	23
Mount Darwin	9.51	8.25	15
Mount Nuza	10.45	14.59	23
Mtoko	8.90	7.77	16
New Year's Gift	5.48	7.65	14

Station.	Inches.	Normal.	No. of Days.
Nuanetsi	4.26	4.33	5
Plumtree	6.83	6.30	14
Que Que	6.08	6.83	17
Rusapi	6.90	7.56	13
Salisbury	9.47	7.37	21
Shabani	0.77	5.87	8
Sinoia...	8.86	8.14	24
Sipolilo	9.17	8.52	20
Stapleford	10.43	16.81	23
Umtali	5.52	8.11	17
Victoria Falls...	5.15	6.95	15
Wankie	1.94	6.49	11
Abercorn	8.12	—	16
Balovale	10.83	—	20
Broken Hill	13.97	—	23
Fort Jameson...	10.64	—	23
Fort Rosebery	6.69	—	19
Isoka	5.25	—	13
Kalomo	10.42	—	18
Kanchindu...	3.15	—	8
Kapiri Mposhi	8.84	—	18
Kasempa...	9.78	—	21
Livingstone	5.34	—	17
Lusaka	11.21	—	23
Mankoya	6.83	—	11
Mazabuka	12.67	—	21
Mkushi...	7.79	—	21
Mongu	13.47	—	22
Mpika	13.54	—	23
Mporokoso...	9.47	—	25
Mufulira	11.30	—	25
Mumbwa	9.05	—	25
Mwinilunga	10.35	—	24
Namwala	10.07	—	16
Ndola	13.19	—	24
Petauke	9.23	—	22
Senanga	5.04	—	17
Sesheke	3.58	—	15
Solwezi	14.15	—	23

JANUARY, 1939

Station	Altitude (Feet)	Temperature in Stevenson Screen at 4 feet °F: 8-30 a.m. Dry Bulb.	Wet Bulb.	Dew Point	Vapour Press. Deficit	Maximum	Minimum	Max. + Mim. ÷ 2	Absolute: Maximum	Date	Minimum	Date	Number of Days: Max. > 85°	Max. < 70°	Min. > 65°	Min. < 40°	Mean of 24 hours	Pressure Millibars: 8-30 a.m. Station Level	8-30 a.m. 1200 gdm.	Mean of 24 hours	Cloud Tenths	Sunshine Hours
Beitbridge...	1,486	76.7	69.4	65	9.5	88.6	68.4	78.5	97	22	62	22	23	...	27	...	78.0	962.2	881.9	960.4	5 0	...
Bindura...	3,700	69.8	65.3	63	5.5	79.7	64.3	72.0	85	23	61	18	...	...	6	...	70 1	...	...	...	6.9	...
Bulawayo	4,393	67.6	63 0	60	5.4	77.9	59.8	68.9	86	23	51	21	1	3	...	...	68.7	868 0	879.6	866.7	7.0	7.5
Chipinga	3,685	69.2	64 8	63	5.4	77.0	61.0	69.0	90	5	58	21	1	2	1	...	68.8	891.1	880.4	...	7.4	...
Enkeldoorn	4,808	66.4	62.3	60	4.7	76.8	59.8	68.3	84	23	54	21	...	...	...	...	66.5	856.0	879.7	...	6 7	...
Fort Victoria... ...	3,571	68.6	64.3	62	5.2	80.1	62.0	71.1	88	30	55	21	5	..	2	...	70.0	893.9	879.8	892.8	6.0	...
Gwaai Siding... ...	3,278	70.9	65.6	63	6.6	85.3	62.9	74.1	94	23	55	21	13	...	3	...	...	902.7	879.5	...	6.7	...
Gwanda...	3,233	71.3	65.2	62	7.3	82.8	62.9	72.8	93	23	57	21	12	...	6	...	72 2	904.6	880.0	...	6.4	...
Gwelo	4,629	67.1	62 6	60	5.2	77.6	60.2	68.9	87	23	55	21	1	1	...	...	66.9	860.9	879.5	...	6.8	...
Hartley...	3,879	69.6	64.9	62	5.6	78.7	62.2	70.5	86	23	57	18	1	...	1	...	68.9	883.9	879.4	...	7 3	...
Inyanga...	5,503	65.8	61.3	59	5.0	72.6	57.4	65.0	78	23	50	29	..	5	...	...	63.7	...	..	...	6.3	...
Marandellas	5,453	64 5	60.5	59	4.3	73.2	58.2	65 7	80	22	53	21	...	...	...	...	63.7	...	...	...	8.0	...
Miami	4,090	67.3	64.5	63	3.3	77.3	62.2	69 7	84	23	60	2	...	1	...	...	68 3	877.2	879.2	875.5	6.9	...
Mt. Darwin	3,179	71.2	66.8	64	5 6	80.5	65.7	73.1	86	23	62	23	2	...	17	...	70 7	...	...	...	7.9	...
Mount Nuza	6,668	57.2	56.3	56	0.9	64.5	52 9	58 7	69	23	49	15	...	31	...	...	...	800 2	880 0	...	7.9	...
Mtoko	4,136	68.8	64.0	61	5.6	75.4	61.8	68.6	82	23	59	14	...	1	...	...	67 3	876.2	879.8	875.0	6.4	..
New Year's Gift...	2,690	72.6	67.0	64	6.8	82.2	62.6	72 5	90	30	59	22	5	..	3	...	...	...	...	...	..	5.6
Nuanetsi	1,547	75.6	69.3	66	8.2	86 1	66.1	76 1	95	30	60	21	17	...	15	...	...	960.3	880.6	...	5 9	...

JANUARY, 1939 (continued)

Station	Altitude (Feet)	Temperature in Stevenson Screen at 4 feet °F: 8-30 a.m. Dry Bulb	8-30 a.m. Wet Bulb	8-30 a.m. Dew Point	8-30 a.m. Vapour Press. Deficit	Maximum	Minimum	Max + Mim. ÷ 2	Absolute Maximum	Date	Absolute Minimum	Date	Number of Days Max > 85°	Max < 70°	Min. > 65°	Min < 40°	Mean of 24 hours	Pressure Millibars 8-30 a m Station Level	8-30 a m 1200 gdm	Mean of 24 hours	Cloud Tenths	Sunshine Hours
Plumtree	4,549	68.5	62.9	60	6.6	79.5	60.1	69.8	88	23	55	22	2	..	..	...	..	..	...	..	4.6	...
Que Que	3,999	69.4	64.5	62	5.9	80.2	62.3	71.3	89	23	56	21	2	.	3	...	69.2	880.4	879.6	879.0	6.7	...
Rusape	4,648	67.4	62.6	60	5.5	76.4	60.6	68.5	84	23	56	21	.	1	..	.	57.0			...	5.7	...
Salisbury	4,831	66.7	62.4	60	4.9	76.2	59.7	68.0	83	23	56	18	..	1			66.3	854.9	879.6	853.7	8.2	5.6
Shabani	3,131	72.0	65.5	62	7.8	83.5	63.8	73.6	92	23	56	21	11	...	11	..	72.5	.	..	...	6.8	.
Sinoia	3,795	70.5	66.3	64	5.2	79.4	63.3	71.4	86	23	59	18	1	1	3	..	69.1		..	...	6.2	...
Sipolilo	3,876	69.9	65.4	63	5.5	77.8	61.6	69.7	81	23	59	23			...	...	..	...		.	6.7	..
Stapleford	5,304	63.7	60.6	59	3.4	71.6	55.8	63.7	76	23	49	21		4		...	62.4	..	...	..	7.1	.
Umtali	3,672	70.4	65.8	63	5.6	80.2	62.9	71.5	86	30	59	24	1	.	3	...	69.9	891.1	879.2	..	6.1	...
Victoria Falls... ...	3,009	72.2	68.0	66	5.5	86.5	65.6	76.0	97	23	62	21	21		18	...	73.3	.	.	.	6.1	..
Wankie...	2,569	75.5	69.3	66	8.0	90.4	68.5	79.5	99	23	66	16	27	.	31	...	77.5	924.9	879.4	..	5.7	...
Abercorn	5,458	65.5	61.2	59	4.8	75.6	58.0	66.8	82	27	51	29	..	2		...	...	837.0	880.3	...	4.3	.
Broken Hill	3,911	66.9	64.9	64	2.3	78.9	62.8	70.9	84	23	59	22	...		2	...	..	883.2	879.4	...	7.8	3.8
Chipili	3,900	68.1	65.3	64	3.4	81.9	64.2	73.0	87	12	62	9	2	.	5	.	.		...	...	.	...
Fort Jameson .	3,815	69.3	65.3	63	4.8	79.7	63.9	71.8	85	9	61	22	...		4	.	.	886.7	880.2	...	6.8	...
Kasama	4,562	66.5	63.5	62	3.5	78.6	61.1	69.9	84	12	57	29	.	.	...	.	.	864.3	880.8	...	...	...
Kasempa	4,500	64.5	62.7	62	2.0	79.2	60.5	69.8	84	5	57	22	.		...	..	...	.	..	..	..	...
Livingstone	3,051	70.0	67.4	66	3.2	85.1	64.8	74.9	92	23	61	22	17		9		.	909.3	878.6	907.6	7.1	..
Lusaka	4,193	67.1	64.8	64	2.7	77.1	62.6	69.9	82	12	60	22	..	.	1	...	.	873.8	879.0	..	8.1	...
Mazabuka	3,385	69.2	66.9	66	2.7	80.3	64.6	72.5	85	23	62	10	.	.	9	..	..	..	..	...	..	..
Mongu	3,481	70.8	67.8	66	3.7	84.6	65.6	75.1	91	12	64	11	14	.	22	...	...	895.5	879.5	.	5.8	...
Mpika	4,620	66.3	63.5	62	3.3	77.2	60.9	69.0	84	14	58	22	.	1	...	...	...	861.9	880.3	...	8.2	...
Mwinilunga	4,450	65.1	64.0	64	1.2	77.6	60.5	69.0	84	26	59	23	..	1	.	..	...	.	.	...	..	...
Ndola	4,190	66.1	64.3	63	2.1	78.2	62.3	70.2	83	12	59	22	..	..	...	..		874.8	879.8	...	8.2	...

Rainfall in January, 1939, in Hundredths of an Inch. Telegraphic Reports.

Area	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	Total	Normal
1	160	18	23	...	...	...	1	9	35	28	15	13	16	13	...	...	...	...	...	...	...	...	...	10	21	32	13	...	4	29	12	452	533
2	32	13	5	7	...	...	15	25	81	11	...	...	31	7	13	5	1	3	2	...	2	...	...	...	...	3	...	...	...	26	8	290	742
3	34	28	11	97	3	3	59	135	41	1	1	...	31	25	25	50	5	29	17	1	...	...	...	7	20	9	...	...	...	...	11	643	1087
4	31	79	9	37	2	1	25	40	46	14	45	7	12	1	1	10	...	...	1	...	...	...	...	6	37	19	19	...	1	51	35	529	697
5	96	3	21	...	...	4	1	4	21	14	34	18	12	3	8	21	...	...	...	...	...	...	5	10	7	24	14	45	64	23	12	464	663
6	33	61	64	18	30	9	15	23	42	13	10	71	50	4	34	1	...	...	...	...	...	...	...	...	21	25	8	60	11	1	26	630	746
7	28	65	56	53	41	17	6	55	49	38	27	3	50	50	1	24	11	3	3	...	1	...	...	...	6	20	32	...	6	29	55	729	911
8	24	7	23	63	92	41	14	16	51	52	33	28	22	37	31	3	13	4	12	1	7	9	...	1	54	45	53	16	33	25	49	859	835
9	68	6	40	51	29	40	32	10	40	52	10	20	39	17	82	3	13	26	12	...	12	1	1	17	70	18	32	162	3	25	26	957	855
10	77	16	...	168	16	174	...	18	13	7	...	...	72	63	...	4	38	28	21	...	5	...	...	...	...	103	1	...	...	87	10	921	824
Mean	72	28	28	29	15	19	12	21	42	24	18	18	31	16	19	9	5	6	4	...	2	1	1	6	22	26	16	35	15	28	22	591	730

Southern Rhodesia Veterinary Report.

DECEMBER, 1938.

DISEASES.

Anthrax was diagnosed on the farm Umgambi, Victoria district. Mortality: one head of cattle.

TUBERCULIN TEST.

Twenty-seven bulls and 2 heifers were tested upon importation with negative results.

MALLEIN TEST.

Twenty horses and 12 mules were tested during the month. No reactions.

IMPORTATIONS.

From United Kingdom: Bulls 1, heifers 2.

From Union of South Africa: Bulls 26, horses 17, mules 12, sheep 1,260.

From Bechuanaland Protectorate: Sheep 160.

EXPORTATIONS.

To Union of South Africa: Oxen 22, horses 3.

To Northern Rhodesia: Sheep 44.

To Portuguese East Africa: Oxen 175, calves 6.

EXPORTATIONS—MISCELLANEOUS.

To United Kingdom: Chilled beef quarters 3,337.

To Northern Rhodesia: Beef carcases 389, mutton carcases 22, pork carcases 2, veal carcases 14.

To Belgian Congo: Beef carcases 90, mutton carcases 18, veal carcases 74, pickled beef 8,585 lbs.

Meat Products—From Liebig's Factory.

To Union of South Africa: Corned beef 89,136 lbs.

B. L. KING,
Acting Chief Veterinary Surgeon.

Southern Rhodesia Veterinary Report.

JANUARY, 1939.

DISEASES.

No fresh outbreaks of scheduled diseases.

TUBERCULIN TEST.

Six head were tested upon importation with negative results.

MALLEIN TEST.

Twelve horses and 5 donkeys were tested during the month. There were no reactions.

IMPORTATIONS.

From Union of South Africa: Bulls 1, horses 12, donkeys 5, sheep 1,027.

From Bechuanaland Protectorate: Sheep 563, goats 60.

EXPORTATIONS.

To Northern Rhodesia: Bulls 18, cows 18, calves 6, pigs 4.

To Portuguese East Africa: Cattle 83 head, goats 40.

EXPORTATIONS—MISCELLANEOUS.

To United Kingdom: Chilled beef quarters 3,974.

To Northern Rhodesia: Beef carcases 41¼, mutton carcases 35, pork carcases 9, veal carcases 6, tripes 2,250 lbs., tongues 791 lbs., hearts 1,675 lbs., livers 149 lbs.

To Belgian Congo: Beef carcases 152½, mutton carcases 16, veal carcases 17, tongues 313 lbs.

To Union of South Africa: Corned beef 74,216 lbs., rolled beef 180 lbs.

To Bechuanaland Protectorate: Corned Beef 2,100 lbs.

S. A. MYHILL,
Chief Veterinary Surgeon.

SOUTHERN RHODESIA

Locust Invasion, 1932-39.

Monthly Report No. 74. January, 1939.

Winged swarms of the Red Locust (*Nomadacris septemfasciata*, Serv.) have been reported from the following districts during the month of January, namely: Lomagundi, Darwin, Mazoe, Mtoko, Umtali, Bikita, Victoria, Ndanga, Gwanda and Belingwe. All the swarms were in breeding condition and practically all were engaged in egg-laying.

Hoppers have appeared in the districts of Lomagundi, Darwin, Mrewa, Inyanga, Melsetter (Chipinga), Bikita, Charter, Ndanga, Chibi and Belingwe.

The hoppers are being destroyed in all accessible localities.

The position generally appears to be very similar to that obtaining during January, 1938, although rather fewer reports of locusts have been received. Hatchings appear to have commenced nearly two weeks earlier during the present season compared with last year.

RUPERT W. JACK,
Chief Entomologist.

NOTICE

The Agricultural Journal of S. Rhodesia

is issued by the Department of Agriculture, and can be obtained upon application to the Editor. The Annual Subscription, which must be paid in advance, is 5/-, and payment may be made by any means other than by stamps.

A 10/- note will cover the subscription for two years.

Persons residing outside Southern and Northern Rhodesia may become subscribers by paying 2/- in addition to the subscription, to cover postage.

If payment is made by a cheque drawn on a bank outside Rhodesia, commission must be added.

All cheques and postal notes must be made payable to the Secretary for Agriculture and Lands.

Date..........................19.....

To the Secretary,
Department of Agriculture and Lands,
Salisbury.

Please enrol me as a subscriber to the "Rhodesia Agricultural Journal" for one year from....................................

19......, *for which I enclose*...

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THE RHODESIA

Agricultural Journal

Edited by the Director of Agriculture.

(Assisted by the Staff of the Agricultural Department).

PUBLISHED MONTHLY.

Subscription: 5/- per annum; payable to the Accountant, Department of Agriculture, Salisbury.

Vol. XXXVI.] April, 1939. [No. 4.

Editorial.

Contributions and correspondence regarding subjects affecting the farming industry of Southern Rhodesia are invited. All communications should be addressed to:—The Editor, Department of Agriculture, Salisbury. Correspondence regarding advertisements should be addressed:—The Art Printing Works, Ltd., Box 431, Salisbury.

Prices for Baconers.—The Minister of Agriculture and Lands has approved in terms of section 24 of the Pig Industry Act, 1937, of the following minimum prices fixed by the Pig Industry Board to be paid for pigs sold for slaughter, of which the carcases are liable to grading under the said Act, with effect from the 10th March, 1939:—

Baconers.

Grade A (Selected)	5d.	per lb. live weight.
Grade B (Choice)	4½d.	per lb. live weight.
Grade C (Standard)	4d.	per lb. live weight.

provided that a deduction of one-eighth of a penny per lb. from the aforementioned minimum prices may be made on all pigs which, in the opinion of the Government grader, show—

(*a*) deficient bellies;
(*b*) seedy cut; or
(*c*) deficient hams.

Soil Samples for Analysis.—A number of farmers, chiefly tobacco growers, have made enquiries recently concerning the correct manner of taking soil samples for analysis. Bulletin 758 is available free of cost to farmers in the Colony, giving full instructions for taking representative samples and also particulars of what information should be submitted with all samples sent in. It should be noted that soil samples must be sent carriage paid to the Chemistry Branch, Department of Agriculture, Salisbury. A partial analysis sufficient to determine the suitability of the soil for particular crops and advice concerning fertiliser treatment are provided free of charge for *bona fide* farmers in Southern Rhodesia.

It must be clearly understood that for a soil analysis to be of any value the sample submitted for the purpose should be as representative as possible of the area under consideration. A few handfuls scraped at random from the most convenient spot are not only useless for a fair test, but are liable to mislead the Chemist when he gives fertiliser and cultural advice for the land of which they are intended to indicate the general character. A report given upon a soil sample taken in a haphazard fashion may be worse than useless.

For each land of the same type a mixed sample from the top 8 inches of soil at least six different spots taken as explained in the Bulletin is sufficient, provided the samples are thoroughly mixed. About 5 lbs. of the mixed sample should be sent in for each analysis.

Charges for Analysis.—The following charges apply for analysis by the Chemistry Branch. Samples must be delivered carriage paid to the Chemistry Laboratory, Salisbury, and the charges for the analysis must be paid in advance.

Partial analysis of soil samples from *bona fide* farmers to determine suitability for crops and/or to make manurial recommendations... Free

	£	s.	d.
Complete analysis of soil sample, including report and recommendations	£4	4	0
Partial analysis of any unregistered fertiliser or feeding stuff: For each constituent	0	15	0
Partial analysis of any registered fertiliser or feeding stuff, taken according to provisions of Fertilisers, Farm Foods, Seeds and Pest Remedies Ordinance	1	1	0
Complete analysis of any unregistered fertiliser or feeding stuff	3	3	0
Complete analysis of a registered fertiliser or feeding stuff, taken according to provisions of Fertilisers, Farm Foods, Seeds and Pest Remedies Ordinance	4	4	0
Analysis of water for agricultural purposes	0	10	6
Limestone: Estimation of lime content	0	10	6
Limestone: Complete analysis	1	1	0
Milk, cream or butter: For each constituent	0	10	6
Milk, cream or butter: Complete analysis	1	1	0
Cattle dips	0	10	6
Viscera of animals: Arsenic	0	10	6
Viscera of animals: Stychnine, cyanide, nitrates or copper	1	1	0
Viscera of animals: General examination for poisons (depending on time involved) ... from	3	3	0

Clean up in April.—Agricultural cleanliness operations for April and May appear to be rather like an autumnal "spring cleaning," but it must be remembered that most of these operations mean less work later and prepare for better crops the following season. Uprooting work is easier and more effective if done before the soil becomes dry and hard.

Clean out tobacco grading and bulking sheds, etc., regularly and burn or compost the refuse without delay. As soon as the crop is marketed, clean these buildings thoroughly and treat them with hot limewash. Clean out curing barns within a month of their last firing. Uproot tobacco stalks while the soil is still soft, so that fewer large roots are left behind to produce re-growth. Burn them when they are dry enough. Check up tobacco seed-beds for re-growth or young plants that have come up since the beds were dug over. Destroy that healthy looking tobacco plant that has come up next to one of the walls of your sheds.

When cutting maize for stooking, cut as low as possible so that the remaining portions of the stalks can be properly buried by the plough. This helps to prevent the emergence of stalk borer moths in the planting season. The stook refuse can be suitably disposed of not later than November.

In the orchard and garden collect and destroy stung or fallen fruits to avoid breeding fruit flies and False Codling Moth. Remove all old cruciferous plants such as cabbage, turnips, stocks, alyssum, etc., as they encourage Bagrada Bug, a pest of crucifers that become increasingly severe during the dry months.

CLEANLINESS AIDS INSECT CONTROL.

Trees and Wild Flowers.

ON THE RHODESIAN FARM.

By CHAS. K. BRAIN, M.A., D.Sc., Director of Agriculture.

PART IV.

TWO DANGEROUS GARDEN SHRUBS.

Fam. *Apocynaceae*.

Thevetia neriifolia *Juss.*—A much-branched shrub up to 15 feet high with narrow glossy leaves and tubular, twisted yellow flowers. The fruit is up to 2 inches in diameter and contains one or two seeds. (Fig. 28.) It is a native of tropical America and is very poisonous. One writer states that a boy who ate a single seed commenced vomiting within half an hour and died convulsed within two hours. One can see this plant growing in some of our school-grounds without any warning as to its dangerous character.

Nerium oleander *L.*—This plant, commonly known as Oleander, Ceylon Rose, etc., is common in gardens. Two varieties, the white and the pink flowered are about equally common and equally poisonous. (Fig. 29.) The leaves, bark and wood have been known to be extremely poisonous to man and animals for centuries. There are numerous records of cases of poisoning both in South Africa and in Asia, where the plant grows wild. A number of soldiers died as a result of using Oleander sticks as skewers to cook meat over a fire. A puppy died within half an hour of having chewed a stick of Oleander when romping with a child. It has been stated that a single growing top of a plant proved fatal to horses and cattle and that fowls, ducks, geese, goats, horses and cattle have been poisoned by Oleander. The plant contains two drugs which act very much like digitalis and death is due to heart failure and paralysis of the breathing muscles. Stimu-

lants such as alcohol or strong coffee should be given and medical assistance sought immediately if poisoning from Oleander is suspected.

The Gloriosa Lilies. Fam. *Liliaceae*.—Two species of *Gloriosa* occur commonly in the country, usually flowering on the watershed in March and April. Both grow from tubers and usually have climbing stems and leaves which terminate in tendrils. They grow to perfection on the large termite mounds near river banks and are then usually found scrambling over the trees and shrubs up to a height of six to eight feet. When grown in less favourable conditions they may grow as single stems only about eighteen inches high. The flowers vary from plain yellow to bright red and yellow, or even deep purplish red and yellow. The three sepals are exactly like the petals, and for that reason the six together are called the perianth. There are six stamens and the pistil bends at right angles to the tip of the ovary. The two species are very similar, but in *Gloriosa superba* Linn the edges of the perianth segments are folded and twisted (Fig. 30.), whereas in *G. virescens* Lindl. they are smooth and flat. *G. superba* is common in India, where it is stated that all parts of the plant contain a deadly poison known as superbine.

Physalis minima Linn. Fam. *Solanáceae*.—This is commonly called the wild Cape Gooseberry, as it is closely related to the cultivated species which is *Physalis peruviana* Linn. It is a common weed with the erect stems much branched and varying in height from a few inches up to 2 feet. The stems are prominently ridged and often purplish in colour. This plant is not hairy like the cultivated variety; the flowers are very small, yellow, often with a purplish centre, and the fruiting calyx is usually about an inch long, with prominent veins which are generally tinged with purple. The fruit is not used as it has a disagreeable odour and taste (Fig. 31).

Nicandra physaloides Gaertn. Fam. *Solanaceae*.—This is one of the commonest weeds of gardens and farms in Southern Rhodesia. Plants only a few inches high can be found flowering on hard roadsides, but when the conditions are favourable bushes up to five feet in height are common. The large flowers (Fig. 32) are white with pale mauve or blue margins and with five deep royal blue spots in the bottom of the bell.

Fig 28.—*Thevetia nerifolia* Juss. A poisonous shrub often grown in gardens

Fig 29.—*Nerium oleander* Linn Oleander or Ceylon Rose A poisonous shrub often grown in gardens

Fig. 30.—*Gloriosa superba* L. The common *Gloriosa* lily which is said to be poisonous

Fig 31.—*Physalis minima* L. The wild Cape Gooseberry which is a common weed

Fig 32 —*Nicandra physalloides* Gaertn A very common weed

Fig 33 —*Cosmos bipinnatus* Cav, which has now become a weed in many places

Fig. 34.—*Nymphaea capensis* Thunb. The only common water lily in the country.

As the seed berry develops the inflated calyx expands until it looks something like a Cape Gooseberry fruit, and this accounts for the scientific name *physaloides*. This plant, which is a native of Peru, is now common in most tropical and sub-tropical countries.

Cosmos bipinnatus Cav. Fam. *Compositae*.—This is a garden flower which has taken possession of roadsides, railway strips and waste land near towns in this country and is looked upon as a weed by many people. The abundance of pollen produced when the plants are in full flower is said to be a common cause of hay-fever (Fig. 33). The golden-flowered variety is known as *Cosmos sulphureus* Cav.

Nymphaea capensis Thunb. Fam. *Nymphaeaceae*.—This is the only water-lily commonly found in the streams of this country. It has been known for many years by the name *N. stellata* Willd. During a botanical expedition arranged by the Swedish Botanical Museum in 1936, however, a number of the old names of the plants of Southern Africa were investigated and it was decided that the old name given by Thunberg in 1794 to 1800 had to be retained for this water-lily. It is a most variable plant. The flowers vary from 2 to 10 inches in diameter and may be white, blue, purple or rose in colour. Some are fragrant and others have no scent. The leaves likewise vary from a few inches up to a foot in diameter (Fig. 34). The small snails which are responsible for the infective stage of the bilharzia organism are very fond of the stems and undersides of the leaves of this plant.

Cleanliness Aids Insect Control.

Three Important Strawberry Diseases

By J. C. F. Hopkins, D.Sc. (Lond.), A.I.C.T.A., Senior Plant Pathologist.

Now that growers are preparing to plant out runners for the coming season, it is of great importance that the symptoms and development of certain diseases of strawberries should be understood.

It is sad to relate that owing to the depredations of these diseases, it is almost impossible to-day to purchase large, sound and good flavoured strawberries in Rhodesia. Some years ago the famous " Vumba " variety, as it is known, produced fruit of excellent flavour and size and good carrying qualities. To-day, owing to degeneration of the original stock caused by virus diseases, small, sour, poorly flavoured fruit only is produced.

For many years the gradual degeneration of this variety was attributed to attack by mildew, the symptoms of which generally mask those of the virus diseases. It is only in the last two years that it has been possible to find time for the trouble to be investigated, and it is now known that in addition to mildew, two serious virus diseases, known as "yellow edge" and " severe crinkle," are widely distributed in the Colony.

Strawberries are still marketed in fair quantity and some growers report high yields in their crops, but the fruit produced by the varieties which are apparently virus-resistant compares very unfavourably with that grown eight or ten years ago.

Mildew also causes serious losses annually but may be controlled by suitable methods, so that it is hoped that the following will be of assistance to those growers who are anxious to increase production.

MILDEW.

This disease is caused by the fungus *Sphaerotheca Humuli* and appears to do considerable damage wherever strawberries are grown. Most varieties grown in the Colony are susceptible, so that plant protection measures should be generally applied.

Symptoms.—The first symptoms of mildew are a curling upwards of the younger leaflets. Later on the more mature leaves also show a tendency to curl, their green colour fades to a brownish hue and the underside appears to have a silvery sheen. On closer examination it will be seen that a white powdery coating of mildew is present underneath the leaves, particularly on the young ones in the centre of the plant. Later still, the mildew spreads to the fruit, which may be turned quite white and becomes unfit for consumption. If infection is slight, the fruit may appear sound when picked, but its keeping and carrying qualities are much reduced, so that mouldy rot, caused by the fungus *Rhizopus nigricans*, very soon sets up and makes the affected punnet unsaleable.

Control.—The mildews differ from most other plant diseases in that affected plants may be cured. Mildews are purely surface feeders and the fungi do not penetrate into the host tissues deeper than the epidermal cells. If, therefore, the superficial fungal filaments and spores, which comprise the familiar powdery covering, can be destroyed, then the disease is automatically eliminated. Sulphur sprays and dusts are usually found to be effective in the control of mildews, but close contact between fungicide and fungus is necessary for complete eradication.

Despite the fact that mildews can theoretically be cured, these fungi are generally very persistent, and it is found that prophylactic or preventive measures are in most cases desirable in order to accomplish satisfactory control. In other words, spraying or dusting should commence early in the season and be repeated at intervals until the crop is well advanced.

In Rhodesia, dusting sulphur has given good control when applied at the first signs of disease, which usually appear during the first or second week in August. Special sulphuring dust and not flowers of sulphur should be used and should be

applied by means of a hand bellows or knapsack duster. The machine ought to be provided with a tube extension, at the outlet end of which is fitted a V-shaped piece of sheet metal, bent slightly upwards so as to disperse the dust cloud in an upward direction. The disperser should be placed under the plants and one puff from the dusting machine given to each plant.

In this way the undersides of the leaves are covered with sulphur and a good deal of the powder finds its way on to the young leaves in the crown. Residual sulphur lying on the ground is probably an advantage, for the heat of the mid-day sun causes it to volatilise, which should provide further protection for the plants.

Dusting should be repeated at three weekly intervals until the fruit is well grown, by which time mildew ought to be eliminated from the crop. Late dusting of ripening fruit may cause it to be tainted, especially as it is unusual for rain to fall during the main strawberry season.

Recent work in England[1] has shown that wet spraying with lime-sulphur (2%) plus Lethalate spreader is a satisfactory means of controlling mildew. Trials in Rhodesia also indicate that wet spraying with lime-sulphur plus colloidal sulphur may be more efficient than sulphur dust. At concentrations of lime-sulphur (1%) plus colloidal sulphur ($1\frac{1}{2}$ lbs. per 100 gallons of spray), mildew has been reduced to negligible proportions. Again, in this instance, thorough penetration of the foliage by the spray fluid is necessary, although it is unnecessary to "soak" the plants with fungicide.

In addition to these methods, it is, of course, necessary to practice the usual sanitary measures of removal and destruction of all old leaves and plant débris during the off-season, whilst it is advisable to select runners from mildew-free plants only.

DEGENERATION DISEASES.

Degeneration of plants, which causes them to lose vigour each year until they become small, stunted and non-productive, is caused by several infectious viruses. These viruses

Fig 1 *Top*—"Royal Sovereign" maiden plant affected by "yellow edge" *Bottom* —"Royal Sovereign" maiden plant affected by "severe crinkle"

[After Harris]

are what is known as systemic. In other words, the plant sap is infected, so that the diseases are contained in the runners as well as in the main plant.

The two degeneration diseases which have been identified in Rhodesia are "yellow edge" and "severe crinkle." The latter for a number of years was mistaken for the effect of mildew by growers in the eastern districts. This is not surprising because the most conspicuous symptom of "crinkle" is a distortion of the young leaves. This, combined with the presence of a certain amount of mildew, can easily be confused with mildew damage. The presence of "severe crinkle" has been confirmed by Mr. R. V. Harris, of East Malling Horticultural Research Station, England, who has spent a number of years studying this disease([2]). He has kindly lent the block of the accompanying illustrations of "severe crinkle" and "yellow edge" for reproduction in this journal, due acknowledgement of which is hereby made.

In view of the fact that "yellow edge" and "crinkle" are frequently found in association and that their methods of control are identical, the two diseases will be grouped together for purposes of description and discussion.

Symptoms.—The symptoms of "yellow edge," which is probably identical with the American "strawberry xanthosis," are a yellowing of the margins of the younger leaves, which is accompanied by an upward curling of the edges and downward curling of the midrib, whilst the whole of the leaf blade may be twisted (Fig. 1 top). The leafs stalks (petioles) are short and thick, usually without red pigmentation. The older outside leaves have a more normal appearance, and infected plants may be detected in the bed by their somewhat flat ring of old leaves surrounding a yellow and stunted rosette of younger leaves. The symptoms may vary considerably in intensity from very faint yellowing of leaf edges to a tight cluster of distorted leaves with few or no normal leaves, the spread of the plant being reduced to three or four inches.

Affected plants generally produce small and distorted fruits with a sour flavour. In severe cases little "flesh" develops on the fruit, or flowers may be completely sterile.

The appearance of a "Royal Sovereign" plant infected by the "crinkle" virus (or possibly viruses) is shown in (Fig. 1 bottom). The most striking symptom is the crinkling, twisting and general distortion of the young leaves as they grow out from the crown. This is usually accompanied by the presence of numerous minute yellow spots distributed unevenly over the leaf blades. Later on very small brown spots may develop in the centres of these yellow areas, which extend somewhat with the enlargement of the leaf blade.

The great distinction between "yellow edge" and "crinkle" is that in the former yellowing is confined to the margins of the leaves, whilst in the latter it is distributed in very small spots over the leaf blades. However, as these two diseases are frequently found in association, both types of symptoms may occur on the same plant.

It has been shown in America by Vaughan(3) that the "yellow edge" virus is transmitted from diseased to healthy plants by the strawberry aphis. Although no proof is forthcoming, it is suspected that "crinkle" is transmitted by the same insect.

In Rhodesia, a possible vector of these diseases has been sought for some years, but until very recently no likely insect was discovered infesting strawberry plants. At the beginning of this year, however, an aphid was found infesting, in a mild manner, severely infected plants in the eastern district. The aphids were collected and are being maintained by the Entomological Branch pending further investigations.

Control.—At the moment, control of degeneration diseases depends on planting only resistant varieties of disease-free runners, and secondly in careful rogueing of diseased plants at the end of each season before the runners are selected for planting out. In this connection, control of mildew is an important factor, because the damage caused by this disease frequently masks the symptoms by which degeneration diseases can be recognised.

Should the aphid collected this season prove to be a vector of the viruses, then the control of this insect becomes of imporance. As a precaution it would be as well for growers

to add nicotine sulphate (40%) at the rate of 1 to 800 in their sulphur sprays against mildew, and again the necessity of thoroughly wetting the undersides of the leaves must be emphasised.

SUMMARY.

1. Three serious diseases of strawberries commonly occur in Southern Rhodesia and are responsible for the deterioration of crops in recent years. They are mildew, "yellow edge" and "severe crinkle."

2. Mildew is caused by a fungus, "yellow edge" and "severe crinkle" are due to viruses and cause degeneration of varietal stocks.

3. Mildew can be controlled by sulphur sprays and dusts.

4. "Yellow edge" and "severe crinkle" can only be eliminated by rogueing and planting healthy stocks.

5. The degeneration diseases may be spread by aphids, but confirmation waits upon research results.

6. As a precautionary measure it is recommended that nicotine sulphate be included in the sulphur sprays.

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CLEANLINESS AIDS INSECT CONTROL.

Wheat Production in Southern Rhodesia

By D. E. McLoughlin, Agriculturist.

The production of wheat in Southern Rhodesia has made considerable progress during the last nine years. Production has been stimulated mainly by assistance by the Government in arranging a guaranteed price payable by millers in return for certain rebates of duty on imported wheat. Improved methods of cultivation, including the more liberal use of fertilisers and the employment of the wheat drill in the combined seeding and fertilising operations, and the use of more suitable varieties of wheat have contributed in no small degree to the success of the industry.

During the last eleven years wheat growers have had an assured market at a fixed price, the relative prices paid were 28s. in 1928 to 1930, 23s. in 1931 and 1932 and 22s. 6d. per bag of 200 lbs. in the succeeding years. Commencing in 1932 the fixed price paid for wheat has been for "fair average quality" wheat weighing not less than 62½ lbs. per bushel.

In 1928 there were only 212 European growers with a total of 3,272 acres with an output of 7,000 bags, but as a result of the interest taken by the Government in the industry the acreage and output increased very rapidly, and in 1936 the growers numbered 531, and production reached the record figure of 58,000 bags produced from 22,000 acres. Taking into account the production by European growers only, this output has been estimated to be approximately 50 per cent. of the Colony's local requirements.

The average yield per acre for the whole Colony is not a fair indication of the yielding capabilities of the crop when grown under suitable conditions. The crop is grown both under irrigation and on moisture retaining valley soils, locally termed swamp, or vlei land.

Average farm yields of 10 to 12 bags per acre are not uncommon and a record yield of 17 bags per acre has been obtained from a small acreage in the Mazoe Valley under irrigation. The crop was grown under very favourable conditions. It followed a crop of sunnhemp ploughed under and received a liberal dressing of fertiliser.

Yields comparable with those obtained in other parts of the world can be secured under irrigation with proper management. Approximately two-thirds of the wheat crop is produced on vlei land, without irrigation. Under the latter system yields are considerably reduced by a shortage of moisture or by frost, and crops are often completely destroyed on this account.

Lack of soil moisture and early damaging frosts are the two major factors which control and limit the growing of wheat on swamp or vlei land, and over these the grower has little control. Such measures as fall within the powers of the grower require to be fully exploited to ensure that his risks are reduced to a minimum. These measures include suitable seeding dates, the selection of the most suitable areas on a farm and the building up of these soils to increase their moisture-holding capacity. This can be achieved by green manuring or by the application of organic matter in the form of kraal manure or compost manufactured from farm wastes, veld grass and sunnhemp grown on dry land.

The tendency to increase individual acreages as an assurance against risks is to be deprecated. Economies in the cost of production can best be obtained where a bigger return is produced from a small well prepared acreage.

The crop is a very profitable one grown under irrigation, as the supply of moisture can be regulated to the requirements of the crop, and the frost hazard can be combated by regulating the time of seeding, to ensure the flowering of the crop after the advent of the early damaging frosts.

Date of Seeding.—There is a big variation in the time of seeding wheat in this Colony owing to the different conditions under which the crop is grown, *i.e.*, under irrigation and under swamp or vlei land conditions. In the latter case, soil moisture is the controlling factor, and if the rainfall during

the preceding summer should happen to be below normal, or in the absence of good late rains in March and April, these soils are apt to dry out. In these circumstances the grower has no alternative but to seed early and risk the damaging frosts, which commonly occur in July and early August at the most critical stage of its growth. Often, in an attempt to beat the frost bogey, growers resort to very early planting in March and early April, thereby running the risk of heavy and late rains after seeding and the infection of the crop with rust. Late seeding, from the middle of May to the first week in June—depending on the earliness of the variety—invariably gives the best return if soils are adequately supplied with moisture.

Unseasonable frosts do occur in September, but these frosts are an exception rather than the rule. The recommendation of later seeding applies particularly to the varieties Kenya Governor and Rhodesian Reward, which are both early maturing varieties.

Grazing the Crop.—The grazing of the crop is often practised in other countries. It is a means of preventing a crop which is very forward from coming into flower when severe frosts may be expected. By moderate grazing the growth of a crop can be controlled. Grazing, however, should only be done with sheep, as it has been shown in experiments that on our light sandy vlei soils, larger stock, including calves, pull up the plants on account of the poor root anchorage provided by these soils. Grazing should be light, and should be practised well before the plants begin to "pipe," *i.e.*, before the main shoots grow up.

Grazing will be found most satisfactory on heavy soils and on irrigated crops which afford a better anchorage for the plants. The effect of feeding-off on the yield of grain is largely seasonal and may cause a reduction in the yield; circumstances must decide whether a reduced yield is better than no yield at all, which is often the result of a severely frosted crop.

Rate of Seeding.—The rate of seeding under certain conditions influences the yield; the rate may vary with different varieties. The ideal or optimum rate is the one that will

provide the maximum number of full ears of wheat, which can be produced on a given area. Some varieties tiller more freely than others, and wheat sown early tillers more freely than late seeded wheat; while early maturing varieties tiller less than late varieties.

An adjustment in the rate should therefore be made to meet all these conditions. Experimental evidence indicates that the usual rates of seeding adopted by most growers might be reasonably increased, and that better yields can be anticipated as a result. Seeding rates conducted with Kenya Governor on vlei land and ranging from 4 0to 80 lbs. per acre and rising by 10 lbs., have given a progressive increase. The highest rate has given the highest yield over a period of three years. The moisture content of the soil is a limiting factor and no optimum rate could apply or prove economic under all conditions. On soils well supplied with moisture, growers are advised to compare the higher rates of 50 to 70 lbs. per acre under their own conditions of soil and climate, with the usual rate of 40 lbs. adopted for all varieties.

Fertilisers and Organic Manures.—The results of several analysis of granite vlei land soils have shown that these soils are generally of a rather low inherent fertility, and that they are particularly deficient in the three plant foods—nitrogen, phosphates and potash—which are especially necessary to produce a wheat crop. With the knowledge at our disposal it is obvious therefore that a complete fertiliser is required and that phosphates and potash alone cannot provide the plant food which is necessary to promote growth. Nitrogen is necessary and, is in fact, the dominant fertiliser ingredient for wheat production and requires to be supplied either in the form of fertiliser or by growing a leguminous crop, such as kaffir beans or sunnhemp, and ploughing the whole crop under.

Any deficiency in nitrogen will certainly reflect itself in the ultimate yield of wheat obtained and therefore particular attention should be paid to the supply of this element.

While it is much cheaper to buy the different ingredients separately, and mix them on the farm, than to buy complete fertilisers, it is seldom that the home mixture can be mixed

as thoroughly on the farm as the product turned out with efficient machinery by the fertiliser firms, and where home mixing is done the work calls for European supervision. There are, however, occasions when it may pay a farmer to mix his own fertiliser for application to a crop like wheat, in which case the fertiliser is distributed over the whole area instead of to individual plants in the case of other specialised crops. Farmers far removed from railhead can effect considerable economy in the cost per ton by purchasing highly concentrated fertilisers and further economise greatly on transport. As an example of the saving that he could make by mixing a complete fertiliser on the farm, a mixture of 35 lbs. mono phosphate of ammonia (52% P_2O_5, 11% N.) and 10 lbs. of muriate of potash (60%) will have an analysis 18% P_2O_5, 4% N, 6% K_2O. Fifty-five pounds of filler will require to be added to increase the quantity to 100 lbs. to enable such a small quantity of fertiliser to be evenly distributed. This quantity can be applied conveniently through the fertiliser box of a wheat drill, but if it is required to spread it by hand it will be necessary, in order to secure even spreading, to add an equal bulk of dry sand, soil or sifted kraal manure, which is available on the farm.

By purchasing the potash separately a saving of approximately £2 per ton is therefore made on present-day prices, while the transport costs are further reduced by half. This latter saving is of great importance to areas such as Inyanga, Melsetter and Chipinga, where the cost of road transport on fertiliser varies from 3s. 1d. to 4s. 6d. per bag.

On irrigated land and on vleis reasonably well supplied with moisture, a minimum dressing of 200 lbs. per acre of the mixture should be applied. Readers are referred to Bulletin No. 852, "Mixing of Fertilisers," by the Division of Chemistry.

On acid soils it would be preferable to apply any organic fertiliser in a physiologically alkaline form such as nitrate of soda, nitro chalk, basic slag, etc. It should be remembered, however, that such nitrogenous fertilisers should be applied as a top dressing and not to the crop when planted. This is due to the fact that the nitrogen is in the nitrate form, and

unless the plants are sufficiently developed to utilise the nitrate nitrogen almost immediately, it is liable to be leached or lost in other ways.

Basic slag can be utilised on such acid soils, replacing with advantage such phosphatic fertilisers as ammonium phosphate and super phosphate.

The practice of green manuring irrigated wheat land in the summer is now generally recognised as an essential rotation for wheat. The combination of a green manure and fertilisers is a good substitute for kraal manure. The maintenance of a good supply of organic matter in the soil is very essential, and fertilisers alone cannot maintain or increase the fertility of a soil over a period of years.

Continuous cropping without returning organic matter or humus to the soil will result in the ruination of both the farmer and his soil, which is his bank. Kraal manure performs more than one function in the manurial treatment of soil. It not only supplies the necessary plant foods, but also provides the most essential ingredient of all soils, *i.e.*, humus. Humus is absolutely indispensable in all soils, whether they are irrigated or vlei land soils. Moisture is all important in crop production and humus increases the moisture retaining capacity of a soil and also improves its physical condition.

Owing to their becoming water-logged in the early part of the rainy season, it is not always practicable to grow sunnhemp or even kaffir beans as a green manure crop on the wetter types of granite vleis. In these extreme cases the green manure crop could be grown on high or dry lands, reaped and converted into compost, together with other farm wastes, bedding and veld grass; or by placing these materials in cattle kraals.

Every conceivable effort should be made to increase the humus content of soils for wheat production. It is very pleasing to record the very wide interest which is being displayed all over the Colony in the making of farm compost. Compost is of inestimable value to the wheat grower, and every endeavour should be made to convert all available farm wastes into compost. It is particularly important that the compost should be well rotted when applied to winter crops.

The results of experiments conducted on the Plant Breeding Station, Salisbury, have demonstrated the great value of agricultural lime on granite vlei soils when applied by itself and also in combination with fertilisers and kraal manure. Normally, applications of 1,000 lbs. to 2,000 lbs. per acre will be found beneficial.

Varieties.—The most important varieties grown in the Colony include, in order of popularity, Kenya Governor, Karachi, Klein Koren, Reward, Burbank or Quality, Montana, Punjab 8A, Early Gluyas and Lalkasarwali.

Kenya Governor.—A very early maturing, beardless variety, with good straw. Resistant to stem rust. Is subject to frost injury. Suitable for late sowing. A very popular variety and yields well under most conditions. Recommended for areas subject to rust.

Rhodesian Reward.—A very early maturing beardless variety. Is highly resistant to stem rust. Produces a hard vitreous grain of strong flour strength. Of superior baking quality and value to the baker. Can be sown late. Does best on fertile soils and under irrigation. Increasing in popularity; a variety worth a premium. Gives a good bushel weight beardless. A Rhôdesian strain, bred by the Department of Agriculture.

Pusa 4.—A very early maturing variety. Susceptible to rust. Grain hard, and in the strong flour class. On account of grain shedding readily should be reaped before "dead ripe." Suitable for late sowing and threshing by means of hand power.

Punjab 8A.—A mid-season, bearded variety. One of the best wheats for vlei lands and slightly acid soils. A heavy yielder on both vlei land and under irrigation. Responds well to good treatment. Grain is held tightly. Straw fairly strong and stands well. Fairly resistant to stem rust. A medium strong flour wheat. A very popular variety. Introduced by the Department of Agriculture and highly recommended. Gives a good bushel weight.

Lal Kasar Wali, Klein Koren and Karachi.—The grain and growth habits of these wheats are similar to those of

Punjab 8A. Slightly inferior, and as susceptible to rust as Punjab 8A. Give a good bushel weight.

Quality.—An early beardless variety. Fairly resistant to rust. Grain in the strong flour class. A fair yielder with a good bushel weight.

Several varieties recently introduced by the Department of Agriculture are recommended for trial and are available for free distribution to farmers. These varieties were described in the *Rhodesia Agricultural Journal*, December, 1937, and February, 1939, issues.

Water Requirements.—The amount of water applied to crops is governed by two factors: (*a*) by the needs of the particular plant and (*b*) by the character of the soil. Wheat is a relatively slow growing and deep rooting plant and therefore unlike other quick growing and shallow rooted plants is less dependent on nourishment and moisture from the surface soil. This being the case, the crop should be encouraged to make normal root development. If the soil is reasonably short of moisture the roots will search wide and deep for both moisture and food. If it contains a very liberal amount then root development will be more restricted and confined to the surface where the plant food and moisture is most abundant. Roots of plants go far deeper in dry regions than they do in humid climates. A soil resting on a well drained sub-soil is much warmer than one which is underlaid with wet clay or is ill-drained.

It has been conclusively demonstrated in many parts of the world that nitrifying and nitrogen fixing bacteria are most active in the warmer regions. If the soil is supplied with an excess of water then proper aeration of the soil cannot take place and anaerobic conditions are created, and so nitrification and nitrogen-fixation cannot actively proceed. The normal development of the crop can therefore only take place if the land is well drained and the supply of irrigation water is properly regulated. Surplus water is not only harmful, but is wasteful and increases the cost of production. The general tendency is to over-irrigate.

The seed-bed at the time of planting should not be over-saturated. It should be only sufficiently moist to ensure good germination. The first watering after the crop is up should be delayed to encourage root development. The second watering should be given when the plants are stooling and before they pipe. From this stage until the grain is well formed the crop requires liberal irrigation, and normally two more irrigations are needed, the third being given at the time of heading and the fourth when the grain is well formed. Further irrigations after the crop commences to ripen are wasted, as the roots cease functioning three weeks before the crop is mature. The number of waterings depend on the nature of the soil, and those well supplied with humus are more retentive of moisture. The best guide for the necessity of irrigation at any stage is the appearance of the crop, the need of water being indicated by a flaccid condition of the leaves and the tips of the leaves turning brown.

Soil Erosion on Vlei Land.—Sandy vlei soils erode rapidly and all land under cultivation should be adequately protected by contour ridges and storm drains. Abandoned wheat lands should also be protected and sown to grasses. Many wet vleis, if limed, ploughed and planted with suitable grasses will provide valuable grazing during the spring and winter months, and this will go far to solve the problem of providing the winter feed for stock. Much of the land normally planted to wheat for grain suffers from a shortage of moisture in the latter stages of growth, such crops result in failures or yields are uneconomic. The bulk of green fodder which could be produced comparatively cheaply in the absence of irrigation, commends itself to livestock farmers.

Smut Diseases of Wheat.—The attention of wheat growers has recently been drawn to the seriousness of smut diseases of wheat in an article by Dr. Wickens, which was published in the April, 1936, issue of the *Rhodesia Agricultural Journal.* It was represented to the Department of Agriculture that the crops of certain growers were affected by "smut." The presence of bunt or stinking smut impairs the quality of the flour milled from affected crops, and it is therefore obvious that smutty wheat is of little value to the miller, and that it

commands a considerably lower price. As this form of smut is easily and cheaply controlled it is the duty of the growers to safeguard the wheat industry and also themselves from any financial loss resulting from affected crops.

It is advisable to treat all seed sown to ensure its freedom from the disease. The presence of infection is not always discernable to the naked eye, and although the seed may appear to be free from the disease, many of the grains may carry a few spores, and when sown, give rise to smutted plants. The value and object of seed treatment is to destroy or prevent the germination of the adhering spores.

The "dry method" of treatment with approved fungicidal dusts is strongly recommended.

It is essential that every seed should be thoroughly coated with the dust, and to ensure efficient results the mixing of the grain and the fungicidal dust should be done in a mixing machine. A suitable home-made mixing machine made out of a 40 gallon oil drum is described in the April, 1937, issue of the *Rhodesia Agricultural Journal.*

Another form of smut known as "Loose Smut" also occurs in Southern Rhodesia; this smut, however, does not affect the quality of the flour milled from an affected crop, but it may reduce the yield considerably.

The treatment for loose smut is effected by immercing the grain in several changes of hot water at definite temperatures for a certain time. The method is not "fool proof" and may impair the germination. It is much more satisfactory to purchase new seed from a reliable grower whose seed is known to be free from the disease.

Rust.—The spread of stem rust is favoured by warm and moist conditions, and while the infestation may be more severe in some years than in others, there is no doubt that the disease is on the increase.

Rust is the disease most to be feared, and there is no known treatment which will cure or prevent rust. Control measures can be adopted by paying proper attention to the correct date of seeding and the choice of variety. The dangers of early seeding have already been referred to, and to seed

early is to meet trouble early. The growing of summer wheat is to be deprecated, and there can be little doubt that its cultivation is providing a host for carrying over rust to winter wheat; a continuance of the practice may result in the possible ruination of the whole wheat industry and deprive a large number of farmers of earning a livelihood. The rust menace can only be overcome by plant breeding, and the work is the province of a specialist. The process is of necessity a very slow one owing to the complexity of the problem. There are many physiologic strains of rust and a variety of wheat may be resistant to one or more, and susceptible to others. Research work in Canada has disclosed that there is sex in rust. This recent discovery has provided a new line for the plant breeder to follow in his effort to evolve a variety which will be resistant to all the physiologic strains of rust.

Pests and Diseases.—Spring-hares constitute one of the biggest pests farmers have to contend with on sandveld. They are responsible for considerable damage to the growing crop, which they demolish with relish over the dry winter months. Of the many methods of control recommended and adopted by farmers, few have proved as successful as gassing. The operation is by no means "fool proof," and success with this treatment is usually in proportion to the thoroughness with which it is performed. The numerous burrows lead to a common living room above which there is usually more than one exit hole. The burrows are normally found closed about a foot from the entrance with loose soil, but the air holes or exits above the nest are left open. The efficacy of gassing can only be assured if the burrows are made air-tight and if the lighted cartridges, attached to sticks, are placed about three feet down the air or exit holes.

After inserting the lighted charge and beating the smoke down the hole with a sack for about one minute, the holes are plugged up with pieces of old sacking to render them air-tight. For best results, the charge should consist of three Capex gas cartridges fired together. The cost of gas cartridges is negligible compared with the losses occasioned by this pest.

Open trenches one foot wide with vertical ~~verticle~~ sides, 12 to 18 inches deep, round the fields, have proved a deterrent in some cases.

The Economics of Machinery.—The capital sum which any grower should invest in machinery should be strictly limited to his production. Few farmers possess complete threshing outfits; in most instances the investment in such a plant is not justified. The threshing of the crop is generally done by contractors with itinerant outfits, which are very costly, but do more efficient work than the smaller units which individual growers might be able to afford. Threshing is also done in the Colony by power-driven reaper threshers, of which four are employed, the reaping and threshing being done in the one operation.

So far as the threshing of his crop is concerned, the grower at present is not obliged to incur the cost of expensive machinery. His greatest concern at present and in future is the increasing shortage of native labour. His only salvation brought about by force of circumstances will be the investment individually or communally by growers in labour-saving machinery. The reaping of the standing crop is one of the greatest problems at present confronting the grower. The binder is destined to solve this acute labour shortage and farmers should take stock of the position and guard against being caught by such a contingency as a shortage of labour occurring at the time when the crop is ready for harvest.

The binder and the wheat drill are almost indispensable in the economic production of the crop. The investment in both of these is fully justified. The economies they effect amount to more than their cost over their period of service.

The wheat drill economises in seed, which is a very big consideration on large acreages, since 25 per cent. more seed is required when broadcasting than when drilling. The use of the drill ensures uniform planting and covering of the seed, which results in the more uniform ripening and quality of the crop. Better stands result in increased yields. The combined operations of seeding and fertilising reduce the cost of the two operations, and the fertiliser is more evenly distributed and economically utilised by the plants. A conservative estimate of the number of wheat drills employed by growers is placed at 125, a ratio of four growers to one drill. Many

of the smaller growers share or hire drills for the seeding of their crop, and comparatively little wheat is now broadcasted by hand.

Seed-bed.—The importance of a good seed-bed is not yet fully realised and the operation of rolling, to compact a loose soil, is rarely practised. Wheat requires a firm seed-bed; under irrigation this condition is brought about by the packing of the soil through the application of irrigation water. On vlei lands rolling is necessary to compact the soil. A loose seed-bed is apt to dry out, with the result that all the seed does not come in full contact with moisture, and the tender seedlings have little opportunity of developing.

A rough or loose soil tilth will not allow proper root development if air spaces are too large. After the soil has been rolled and the seed planted, it should be harrowed to break any crusts and to conserve the moisture. A rolling after the wheat is well up, followed by light harrowing, will be found very beneficial on vlei lands.

Purity of Seed.—Wheat is self-fertilised and natural hybrids are rarely found. It is therefore a very easy matter for growers to keep their seed pure. The degeneration of seed can be attributed largely to the carelessness of the farmer in allowing his seed to become mixed with other varieties. Some varieties are very susceptible to rust, and crops grown from impure seed suffer from this defect, and yields are considerably reduced. Seed wheat should be propagated in a special plot and should not be taken from the commercial crop as it comes from the thresher. Pure line seed obtainable from the Department of Agriculture, free of charge, should provide the foundation stock.

The seed plot should be kept carefully rogued when the wheat comes into ear to remove all foreign varieties. Selection should be practised and the best plants growing in normal competition with other plants should be selected, which are true to type for the particular variety, to supply the seed for the breeding plot in the following year. The wheat from the breeding plot should be carefully threshed, preferably by hand, to ensure its freedom from other varieties, and will form the seed for the main sowings each year.

The supply of pure seed to farmers commercially is of vital importance to the industry, and the formation of a Seed Wheat Association, which will ensure this supply, is long overdue. The objects of such an Association would be—

(*a*) To provide for the supply to farmers and others of sound and reliable seed wheat, under the guarantee of the Association in respect to purity, trueness to variety, breed character, and germinating capacity.

(*b*) To make regulations to ensure that the above objects are attained in respect of seed supplied by members of the Association.

(*c*) To examine in consultation with, and under the general supervision and instruction of, the Department of Agriculture, so far as possible and when necessary, seed wheat intended for sale and to apply for leave to certify by a mark that as the result of such examination the wheat is virile and true to type, is free from any serious disease and is practically free from minor diseases.

(*d*) To determine for the particular locality inspection standards for varieties of wheat offered for sale by members. Such varieties to be approved of by the Department of Agriculture.

(*e*) To assist members to dispose of their seed wheat.

(*f*) To promote the more general use by farmers in Southern Rhodesia of certified seed wheat.

(*g*) To provide members with information as to the best methods of production of seed wheat.

(*h*) To advance the interests of seed wheat growers by such other means as may be deemed expedient.

Baking Quality.—The need for improvement in the baking quality of Southern Rhodesian wheat is a live issue with the Department of Agriculture. Not only has publicity been given to the subject, but definite results have been achieved in the development of varieties of improved baking quality. While this "baking quality" standard has been recognised in all parts of the world, I am sorry to say that our Rhodesian growers have not yet developed this consciousness.

Southern Rhodesia is not an exception to the rest of the world; its trade demands varieties of improved baking qualities. In recent years local millers have become extremely interested in the baking qualities of wheat because local bakers are more insistent in their demand for flour of good baking quality.

The baking quality of wheat depends largely both on the quantity and quality of the gluten it contains. While the quantity of the gluten is determined chiefly by the environmental condition under which the wheat has been grown, the quality of its gluten is influenced mostly by the variety, although environment may also have some influence on gluten quality as well.

Dry, hot, quick ripening conditions promote high gluten content in the wheat grain, and such a high gluten content produces hard vitreous grain in some varieties.

The cultivation of a new variety is generally undertaken at the expense of an established variety of similar maturity, and it is pleasing to record the more extended cultivation of Rhodesian Reward in this respect. It is a wheat of early maturity and could therefore replace the early varieties at present grown in the Colony, including Kenya Governor, which appears to be particularly susceptible to frost.

The object of the Plant Breeder in breeding new varieties of improved baking quality has been to ensure that these varieties will yield as well as the varieties they are to replace. That being the case, it is the duty of every wheat grower to test these varieties, which are obtainable from the Department of Agriculture, and which are available for trial under his own local conditions. Should the yields of these improved varieties exceed those of inferior baking quality at present grown by them, then it goes without saying that varieties of improved baking quality may be grown by farmers for increased returns per acre without any advantage of a premium in price. If a premium is eventually paid, so much the better.

Scurvy
AND HOW TO PREVENT IT.

Public Health Pamphlet No. 3.

Historical Note.—Scurvy is a disease which has a long history and in mediaeval times was associated with wars and famines, especially at the times of the Crusades. Later it was identified with long sea voyages in sailing ships, and it is said that in 1497 Vasco da Gama lost 100 out of his crew of 160 men from scurvy. Lind, an English naval surgeon, in 1747, first showed conclusively the value of lemon juice in the prevention and cure of the condition, and in 1795 lemon juice was introduced into regular use in the British Navy. In fact, it was the necessity of having half-way depots for fresh vegetables on the Cape route to the Indies that was responsible for the Dutch settlement at the Cape of Good Hope, and the Portuguese settlement at St. Helena.

Scurvy in Rhodesia.—Scurvy has been recognised in Rhodesia for many years. It is rarely met with in Europeans who, as a rule, have a full and varied diet, though the disease has occasionally been seen in malnourished children. Among indigenous natives living in their own homes under natural conditions the fully developed picture of scurvy is rarely seen. Where natives are employed in large numbers, where the diet is either generally deficient or particularly poor in fresh green food, and where on account of working hours the opportunity of obtaining green food in the *veld* is not available, and where natives are employed in hard manual work, then the condition of clinical scurvy is likely to manifest itself.

The Disease: Its Cause, Signs and Symptoms.—Quite recently the active principle, the anti-scurvy food factor or Vitamin C, has been isolated in a pure chemical form and has been termed ascorbic acid. This substance is an essential requirement for the proper working of the body's complicated mechanism and is particularly associated with the processes of metabolism. If this essential substance is eliminated from

the diet for about six weeks clinical scurvy is likely to result. Normally quite small amounts of this substance taken in the diet even intermittently will prevent the onset of symptoms unless the individual is subjected to greater physical strain than is usually experienced.

It is possible to classify all persons into one of four groups as follows:—

1. **Persons with ample supplies of Ascorbic Acid (Vitamin C) in their Systems.**—When these individuals are given large doses of ascorbic acid the substance is immediately excreted by way of the urine, as the body has no use for the excess. These are normal individuals.

2. **Persons with no margin of Ascorbic Acid (Vitamin C) in their Systems.**—When these individuals are given large doses of ascorbic acid the substance is not excreted, or only small amounts are excreted in the urine, showing that the body has use for the extra supply. This class of person may remain well for long periods of time provided that small quantities of Vitamin C are taken in the diet from time to time and that no excessive manual work or exercise is performed. These individuals might be termed "liable to scurvy" or "sub-clinical scurvy," and in this class fall a great proportion of the native peoples in Africa.

3. **Persons with Early Symptoms of Scurvy.**—These individuals show the earlier signs of Vitamin C deficiency, and quite a proportion of people in the previous group relapse into this group in the months of October and November when on account of climatic conditions fresh vegetable food is at a premium. The earliest signs are general apathy and lassitude and the appearance of small localised swellings, particularly on the face; pains in the limbs and joints are invariably present and are generally far more intense and persistent than those complained of in malaria, influenza, and sub-acute rheumatism. Later the gums become soft and the teeth loose, and the gums bleed easily.

This group may be termed "clinical scurvy," and they are usually able to keep at work, though the ability shown and the amount of work done are considerably diminished. These people may only be recognised as cases of scurvy by

a medical practitioner, and should the feeding conditions for natives on farms and mines predispose to scurvy some persons in this group will be found whenever a frank case of scurvy is seen.

4. **Persons Suffering from Scurvy.**—These persons are unable on account of their illness to continue working, and in this group the classical and severe signs and symptoms of scurvy are manifest. The gums are swollen and bleeding and often grow almost to cover the teeth, which are generally very loose in the gums. Usually there is a marked degree of septic infection and the breath is very objectionable. The patients have bleedings into their joints and muscles and these collections of blood may become the centres for abscess formation. These people bruise easily and they may be crippled by bleeding into joints and muscles and great pain may be caused by bleeding under the tissues covering the long bones of the limbs, particularly the shin bones. In very severe cases bleeding into the urine and from the bowel may occur and the heart may be seriously affected.

It must be realised that the four groups described are not separate entities but are all gradations from the perfectly healthy individual to the unfortunate, dying in the last stages of scurvy.

Why is Scurvy considered a Serious Condition?—Scurvy has always been considered, and rightly so, the most reliable index of defects in the feeding and management of native labour. First, the disease in its florid state is easily recognised and its remedy is in the hands of everyone. Secondly, the occurrence of the disease in labourers who have been employed on the mine or farm for some months is a serious indictment of the feeding standards of the mine or farm in question. Thirdly, the occurrence of scurvy in native labourers soon after their arrival to work on farm or mine means that the ordinary diet is only of minimum standard and does not afford the labourer whose system is put to great strain by manual work the opportunity of building up a sufficient store of Vitamin C for the increased energies of the body.

It is therefore necessary to consider preventive measures on two scales, one applied to the routine requirements of natives in employment and the other more liberal scale applied to natives newly engaged in employment who require building up of their Vitamin C reserve.

(1) Considering the first scale it is essential to ensure that each native receive a weekly ration of fresh vegetable food. In the selection of the type of vegetable to be used the following aspects merit consideration:—

(*a*) The vegetable should be, if possible, a steady and potent source of Vitamin C.

(*b*) The vegetable should be capable of production easily and cheaply, and on a large scale, and should be procurable throughout the greater portion of the year.

(*c*) The vegetable should be of a type liked and used by natives, as some vegetables palatable to the European races are disliked by natives.

(*d*) The less cooking and preparation the vegetable undergoes the better, as prolonged cooking may destroy all the Vitamin C content. Where possible the vegetable should be eaten raw. This is a very important matter.

(*e*) The term "vegetable" is meant to include fruit of many kinds, particularly the citrus fruits, which are a valuable and potent source of Vitamin C. They can be eaten raw and are enjoyed by all natives.

Orange extract concentrates are, of course, a very potent source of Vitamin C and have the value that they are easily transported and are available at times when fresh vegetable food is at a premium. These substances should, however, only be used at times and in special areas where fresh vegetable food is quite unprocurable, for the reason that while the concentrates provide an adequate source of Vitamin C the other vitamins and mineral salts present in fresh vegetable foods are not secured.

The supply of green vegetable foods in the case of small groups of native labour, either on mines or farms, may be relatively easy by using the resources of the veld and vegetables grown under market-garden conditions. For large, well-established mines the supply of fresh vegetable foods should be ensured by long-term contracts with neighbouring farmers, who would thus be induced to cater for a very steady and profitable sideline. There appears to be great lack of co-operation in this matter, and it is suggested that both farmers and miners might with advantage explore a market which with proper organisation might prove profitable in many directions both to the buyer and seller. In considering farms employing large numbers of native labourers, particularly in the tobacco industry, for this farming pursuit has now become an industrial occupation, the growing of vegetables for the native labour force on field scale is an essential matter, being just as important a part of the estate routine as the planting of tobacco and the cutting of timber for curing.

With differing Vitamin C contents of fresh vegetable food in different parts of the country at different seasons of the year it is impossible to lay down rigid minimum ration scales for vegetables, but it is suggested *provisionally* that 3 to 4 lbs. of fresh vegetable food per labourer per week will be ample cover for Vitamin C requirements. Many of the vegetables enumerated are also valuable sources of energy foods, especially the root crops, and in such instances it may be possible to adjust the ordinary ration scale with advantage to allow for the substitution of the energy food. When such a substitution is possible anxiety with regard to scurvy will be largely eliminated, as the partaking of such energy food in sufficient quantities will automatically safeguard the Vitamin C requirements of the individual.

(2) Turning now to the consideration of newly-engaged native labour, it must be realised that to build up a contented, efficient and intelligent labour force it is necessary to take certain steps before the labourer is called upon to bear the full strain of hard and long manual work:—

(*a*) If the labour is engaged for some weeks before the full labour force is required, the newly-engaged natives have time to build up their reserves of strength and

energy after either a long and arduous journey from their home-lands or after maybe years of comparative idleness in their homes. By this measure when the full labour output is required the labourers are ready and able to stand the strain instead of, as now happens, 10% to 20% of the force being off work within a few weeks of engagement.

(b) The newly arrived native labourer is probably in our second group, that is, "liable to scurvy" or "sub-clinical scurvy," and it is necessary to restore the Vitamin C level either by greatly increased rations of vegetables or by the addition of a dose of orange concentrate, five ounces (ten tablespoonfuls) administered twice a week.

APPENDIX.

(1) Sample Rations.

The following scales are suggested as a basis on which individual employers of labour can base their rations to natives at various times of the year. The rations are provisional only, as further investigations in this connection are being made; the rations are therefore subject to modification in the future.

1. **Minimum Ration Scale under Mines and Minerals Act, 1935:—**

(a) *Meal.*—Mealie meal, rapoko, mabele, inyouti and the like, or rice; 1½ lbs. a day.

(b) *Meat.*—2½ lbs. a week. The whole or part of the meat ration can be replaced for variety by *fish*, either 2 lbs. of fish a week or 1 lb. of fish to replace 1 lb. of meat. In instances where the natives are usually meat eaters, fish shall not be issued more often than twice a month.

(c) *Peanuts.*—1 lb. a week, shelled; or 2 lb. a week, unshelled.

(d) *Salt.*—3½ ozs. a week.

(e) *Beans.*—2 lbs. a week.

(f) *Vegetables.*—2 lbs. a week.

2. **Where Vegetable Foods are quite unobtainable:—**

(*a*) *Meal.*—Mealie meal, rapoko, mabele, inyouti and the like, or rice; $1\frac{1}{2}$ lbs. a day.

(*b*) *Meat.*—$2\frac{1}{2}$ lbs. a week.

(*c*) *Peanuts.*—1 lb. a week, shelled; or 2 lb. a week, unshelled.

(*d*) *Salt.*—$3\frac{1}{2}$ ozs. a week.

(*e*) *Beans.*—2 lbs. a week.

(*f*) *Mazoe Orange Concentrates.*—2 ozs. (four tablespoonfuls) a week.

3. **Ration during the Citrus Season:—**

(*a*) *Meal.*—Mealie meal, rapoko, mabele, inyouti and the like, or rice; $1\frac{1}{2}$ lbs. a day.

(*b*) *Meat.*—$2\frac{1}{2}$ lbs. a week.

(*c*) *Peanuts.*—1 lb. a week, shelled; or 2 lb. a week, unshelled.

(*d*) *Salt.*—$3\frac{1}{2}$ ozs. a week.

(*e*) *Beans.*—2 lbs. a week.

(*f*) *Citrus.*—One good lemon or orange three times a week. If small orange culls are issued, one each day will be needed.

4. **Ration using Group A Vegetables (see Section (2)—Appendix):—**

(*a*) *Meal.*—Mealie meal, rapoko, mabele, inyouti and the like, or rice; $1\frac{1}{2}$ lbs. a day.

(*b*) *Meat.*—$2\frac{1}{2}$ lbs. a week.

(*c*) *Peanuts.*—1 lb. a week, shelled; or 2 lb. a week, unshelled.

(*d*) *Salt.*—$3\frac{1}{2}$ ozs. a week.

(*e*) *Vegetables.*—2 lbs. of vegetables in Group A (see below) per week. Where lucerne is available it can be used after careful drying, and is added in a chopped up state to the rest of the food just before serving.

5. **Ration using Group B Vegetables (see Section (2)—Appendix):—**

(a) *Meal.*—Mealie meal, rapoko, mabele, inyouti and the like, or rice; 1½ lbs. a day.

(b) *Meat.*—2½ lbs. a week.

(c) *Peanuts.*—1 lb. a week, shelled; or 2 lb. a week, unshelled.

(d) *Salt.*—3½ ozs. a week.

(e) *Vegetables.*—3½ lbs. of vegetables in Group B (see below) per week.

6. **Ration using Group C Vegetables (see Section (2)—Appendix):—**

(a) *Meal.*—Mealie meal, rapoko, mabele, inyouti and the like, or rice; 1½ lbs. a day.

(b) *Meat.*—2½ lbs. a week.

(c) *Peanuts.*—1 lb. a week, shelled; or 2 lb. a week, unshelled.

(d) *Salt.*—3½ ozs. a week.

(e) *Vegetables.*—4½ lbs. of vegetables in Group C (see below) per week.

7. **Ration for Small Mines and Farms in the Wet Season:—**

(a) *Meal.*—Mealie meal, rapoko, mabele, inyouti and the like, or rice; 1½ lbs. a day.

(b) *Meat.*—2½ lbs. a week.

(c) *Peanuts.*—1 lb. a week, shelled; or 2 lb. a week, unshelled.

(d) *Salt.*—3½ ozs. a week.

(e) *Beans.*—2 lbs. a week.

(f) *Vegetables.*—Where small numbers of native labourers are employed and the season and situation permit, and where the labour force is given the opportunity of collecting it, native spinaches can be obtained in the veld. It is inadvisable to rely on this source of supply from August to November, or where the labour force exceeds 50, unless exceptional measures are taken to collect the spinaches from a wider area.

(2) Vegetables (including Fruit) arranged with Special Reference to their Vitamin C Content.

Smaller quantities of vegetables in Group A will be needed than vegetables in Group B. When using vegetables in Group C the maximum vegetable ration is needed to ensure protection against scurvy. In raising the Vitamin C protection of newly engaged labour it is preferable to rely on substances in Group A only.

Group A. Rich Source of Vitamin C:—

Oranges.
Lemons.
Naartjes.
Pawpaw.
Tomatoes.
Cabbage.
Sprouted peas.
Sprouted cowpeas.
Sprouted beans.
Lucerne.
Spinach.

Group B. Good Source of Vitamin C:—

Lettuce.
Potato (cooked 15 minutes).
Sweet Potato.
Prickly Pear.
Green beans.
Pumpkin.
Pig's Liver.

Group C. Vitamin C present:—

Sprouted Kaffir corn.
Sprouted maize.
Young maize cobs.
Onion (including dried).
Potato (cooked 1 hour).
Dried peas (after soaking).
Fresh cow's milk.
Turnip tops.
Kaffir beer (as prepared under native conditions).

Group D. Practically no Vitamin C:—

Eggs.
Meat.
Boiled milk.
Dried vegetables.

(3) METHOD OF PREPARING PEAS, LENTILS AND OTHER PULSES FOR THE PREVENTION OF SCURVY IN THE ABSENCE OF FRESH VEGETABLES.

1. The dry seeds must be whole, retaining the original seed coat, and not milled or decorticated.

2. They must be soaked in water for about 12 hours. The peas, beans, etc., placed in a clean sack, should be steeped in a trough, barrel or other suitable vessel full of clean water, and should be occasionally stirred. The sack and trough, etc., should be large enough to allow for swelling to about three times the original size.

3. The water must then be drained away and the peas, beans, etc., allowed to remain in a moist condition with access to air and they will then germinate and a small rootlet will grow out taking from 24-48 hours to develop. To ensure this process occurring speedily the peas, beans, etc., should be spread to a depth not exceeding 2 to 3 inches in a trough or other vessel with sides and bottom porous or well perforated with holes; this is to allow complete access of air. The seeds must be kept in a moist atmosphere by covering with a damp cloth or sacking, which is sprinkled as often as required to keep the contents thoroughly moist. All the vessels should be clean.

4. It is important that the germinated pulses should be cooked and eaten as soon as possible after germination, and should not be allowed to become dry again or to become sour. The pulses should not be cooked longer than is necessary to make them eatable, and it seems desirable to emphasise the fact that prolonged cooking destroys the vitamin content and renders the pulse useless for the purpose it is so specifically designed to serve.

Compost

By S. D. Timson, M.C., Assistant Agriculturist.

(*Concluded.*)

SECTION III.

COMPOSTING THE SUNNHEMP GREEN-MANURE CROP.

There is undoubtedly a valuable place for Indore compost in Rhodesian agriculture as a means for eliminating the great waste of organic matter in the maize crop wastes, and the other crop residues which are burnt each year, and also in preventing the great waste of plant food which is being lost from the cattle kraals and feeding pens of the Colony, by the extensive leaching, and denitrification which take place.

However, the writer is convinced that there is a still greater field of usefulness for the modified technique of composting outlined below, which it is suggested should be applied to the sunnhemp green-manure crop.

It is necessary here to make it clear that at present the claims made for the system only apply to the sunnhemp crop, and to the heavier loam soils, and not to other green-manures or to the sandy soils. The evidence on which the system has been designed will first briefly be given.

Defects and Disadvantages of Green-manuring.—Although the practice of green-manuring has been of great value to Rhodesian agriculture, it suffers from the following serious defects and disadvantages:—

(1) A large proportion of a farmer's land is idle and unproductive each year under green-manure.

(2) The manurial value of the green-manure depends too much on factors outside the farmer's control, such as the rainfall following ploughing under, and preceding the planting of the maize crop. Results are variable and undependable.

(3) Much damage is done to the tilth of the heavy soils by the farmer being forced to plough under the crop when the soil is too moist, because he is working against the time factor.

(4) The top growth of the sunnhemp crop only gives a small additional yield from the following maize crop compared with that given by the stubble alone.

(5) Only a portion of the green-manure crop can be ploughed in under the optimum conditions of time, soil conditions, and weather, owing to the slowness of ploughing.

(6) A second ploughing is nearly always necessary, and this is very hard on the oxen, and costs money.

Ploughing in versus Reaping Sunnhemp.—In five different series of experiments covering the past 11 years the increased yield of maize obtained by ploughing under the whole sunnhemp crop, as compared with ploughing under the stubble only, has been as follows:—1.10 bags per acre; 0.99 bag per acre; 1.94 bags; 0.91 bag; and 1.36 bags per acre. The average of these results is 1.26 bags per acre. This is borne out by the observations of experienced farmers, many of whom have informed the writer that they have been able to see no difference in the effect on the following maize crop of ploughing the whole sunnhemp crop in, and the effect of the stubble alone, where part of the crop has been reaped for seed.

It is necessary to emphasise that in this comparison of the manurial value of a sunnhemp stubble with that of the whole crop ploughed under it can only be fairly made where both are of the same stage of maturity. In other words, the effect of a sunnhemp stubble 10 to 12 weeks old cannot fairly be compared with that of a whole crop ploughed in at the

normal stage of maturity, which is about 16 to 18 weeks. From the results of past research, and also from the indications of field experiments which are not yet complete, it can be stated with reasonable certainty that, within certain limits which cannot yet be exactly defined, the more mature a sunnhemp stubble is the greater is its manurial value to a following crop of maize. Furthermore, it must be borne in mind that if the stubble of a sunnhemp crop (or of any other legume) is worked by plough or other implement before the seasonal rains end then a considerable loss of nitrogen and other soluble plant foods will be lost by leaching out to the sub-soil by the rain, particularly during the first month of the following rainy season when the maize crop is too young to take up large quantities of plant foods.

Therein lies one of the main advantages for the farmer of working with a stubble instead of ploughing the whole crop under. He need not (and should not) plough it until the rains finish, and he thus avoids much loss of plant food from the soil, particularly the nitrogen in the form of nitrate.

Manurial Value of Sunnhemp Compost.—*Experimental Evidence.*—In 1935-36 an experiment was laid down at the Agricultural Experiment Station at Salisbury with the object, amongst others, of finding the manurial value of the top-growth of a crop of sunnhemp, when it is reaped and made into compost.

The experiment was designed in the form of ten randomised blocks of six treatments; each plot was 1-20 acre in area. Only three of the six treatments are shown in the table of results given below, since those are the only ones of interest here. The full results were published and fully discussed elsewhere,* but it should be mentioned that the statistical analysis showed that the results were clearly significant, the calculated value of Z being 1.6892, and the observed value of Z at the one per cent. point being 0.6540.

The results are tabulated below, being expressed as the percentage increases in the yield of maize compared with the yield of the two controls reckoned as 100.

*R.A.J., September, 1938. Report on Experiments 1936-37.

Treatment.	Percentage increase in yield of maize compared to the controls reckoned as 100.
The whole sunnhemp crop ploughed under at 14 weeks from date of planting.	135.13
Compost made from the top growth of the sunnhemp crop cut at 14 weeks from date of planting.	139.94
Compost made from the top growth of sunnhemp crop returned to the land on which the crop was grown. Sunnhemp 14 weeks old when reaped.	159.49

It will be seen that the compost made from the top-growth of the sunnhemp crop by the method laid down in Section I. has a rather higher manurial value in the year of application than the whole sunnhemp crop ploughed under.

Reduction of Area of Idle Land under Green-manure Possible.

The above experimental evidence indicates that the farmer can with considerable profit reduce the area of land idle under sunnhemp each year by at least fifty per cent. by composting the top-growth, since the stubble of a sunnhemp crop only gives on the average a yield of maize 1.26 bags per acre less than the whole crop of sunnhemp ploughed under, and the latter appears to be equalled in manurial value by the top-growth of the sunnhemp crop alone, after it has been made into compost.

Gains and Losses.—Before describing the modified system of composting suggested, the potential profits and losses of the system as compared with ploughing under the whole sunnhemp crop may be estimated in the case of a farm in the maize belt with 600 acres under the plough, of which 200 acres are normally green-manured, in order to illustrate the potential benefits of the system.

Under the system suggested only 100 acres of sunnhemp would be grown each year, and the top-growth composted and applied to the other 100 acres which would normally be green-manured. Of course, in the first year no compost is available, and the whole 200 acres should be under sunnhemp, and half or more of it would be composted.

Table of Potential Gains and Losses.

Losses.				Gains.			
(1) 126 bags of maize @ 8/3	£51	19	6	(4) 1,200 bags maize in 3rd year... =	£495	0	0
(2) Cost of making compost @ 1/- per ton, and 10 tons per acre, on 10 acres ... ... =	50	0	0	(5) Saving on 2nd ploughing of 200 acres @ 4/- ... =	40	0	0
(3) Complete fertiliser @ 200 lbs. per acre on 100 acres (14/- per acre) =	70	0	0	Total gains...	£535	0	0
				Total losses	£171	19	6
Total losses	£171	19	6	Nett gains	£363	0	6

The items in the above table may be elaborated as follows:—

Item 1.—This is simply the loss of yield on the 100 acres of stubble due to removing the top-growth, at 1.26 bags per acre, which has been found by experiments over 11 years as specified above.

Item 2.—Compost has been made in this Colony for 1s. 6d. per ton where all the materials were carted to a central site, and much hand labour used. It has been found by one farmer* who has composted 35 acres of sunnhemp tops on the lines suggested here, that the total cost of labour and depreciation on implements and kraals is less than 1s. per ton of compost where the yield of compost per acre is 10 tons.

*Composting the Sunnhemp Crop by P. G. Deeds. R.A.J., Oct., 1938.

It is estimated that the yield of compost per acre of sunnhemp will usually exceed 10 tons for a normally well grown crop in the maize belt.

Item 3.—This is a dressing of 200 lbs. per acre of a complete fertiliser having an analysis of approximately 25.1% P_2O_5 (total) 4.1% nitrogen, and 3% potash. The cost per ton of the materials for mixing on the farm is £6 5s. 0d. approximately. Railage and spreading are reckoned at 15s. per ton. This fertiliser has been used with success for several years by farmers in the Mazoe Valley and elsewhere.

Item 4.—The yield of maize in the third year, on the 100 acres which received compost in the first year, with 200 lbs. per acre of the above fertiliser, is estimated at 12 bags per acre. The average pay out per bag for the past three years is 8s. 3d.

Item 5.—On a sunnhemp stubble, or on a maize stubble, only one good ploughing is necessary, and thus the second ploughing necessary after ploughing in sunnhemp, which is so hard on the oxen, is avoided.

This table of losses and gains is merely intended to assist the farmer, who contemplates a change of system, to decide whether it may be worth his while or not, and it is only suggested that he should test the system on a moderate scale to start with until he has gained experience.

"Hidden" Gains.—Neither the extra cost of riding and spreading the compost, nor the costs of cultivation, reaping and marketing the extra 100 acres of maize are included. It is considered that these items may be more than balanced by the "hidden" gains which are to be expected, but are impossible to estimate accurately. For instance, the normal practice in the maize belt is to sow the sunnhemp crop in dry soil just before the rains. This means that much damage is done to the tilth of the heavy soils by ploughing it under whilst the soil is still moist during late February and early March, whereas in the system suggested the sunnhemp stubble should not be disturbed until the soil is dry, or almost dry.

Moreover, in a proportion of years heavy losses of maize may be caused, probably by leaching out of nitrogen by late rains in March and April, and particularly by the first month's rain of the following wet season, when green-manure crops are ploughed under in late February and early March. This is very well illustrated by the results of an experiment published in the October, 1937, issue of this Journal, where a sunnhemp crop of approximately 14 weeks' growth in each case was ploughed under at fortnightly intervals from February 21st to April 21st, 1936. The results are tabulated below.

Sunnhemp crop (in each case 14 weeks old) ploughed under on:	Yield of following maize crop per acre in bags of 200 lbs.	Percentage increase in yield due to later date of ploughing under.
February 21st 1936	14.22	100
March 7th, 1936 ...	15.36	108.08
March 21st, 1936...	16.75	117.78
April 6th, 1936 ...	17.56	123.41
April 21st, 1936 ...	17.75	124.89

The rainfall during March, 1936, was 5.44 inches, and during April, 1936, 0.56 inches of rain fell.

Since the sunnhemp crop was approximately the same age in each case at ploughing in, it is probable that the losses in yield of the following maize crop are due to the too early nitrification or rotting of the sunnhemp, and subsequent losses of plant foods due to leaching by rain. Much of this loss was no doubt caused by the first rains in November,1937, before the young maize was able to take up the available nitrogen; certainly in the case of the sunnhemp ploughed in on the 6th and 21st of April, since only 0.30 inch of rain fell after the 31st March, and this fall was preceded by a dry period of several weeks and therefore probably had no leaching effect.

Losses by Leaching of Plant Foods Avoided.—Where the top-growth of a sunnhemp crop is removed for composting and the stubble left undisturbed until the cessation of the seasonal rains, these large losses should be avoided, since the micro-organisms in the soil require not only moisture but the ample supply of air brought about by ploughing to enable them to

convert the insoluble organic nitrogen, and other plant foods, in the sunnhemp stubble, into the soluble forms, which are subject to leaching by the rain.

In connection with the losses of nitrogen in the soluble nitrate form by leaching there is one point of great importance, which is usually lost sight of, and that is that nitrate does not pass out of the soil by itself. It must be in combination with some base. For instance, for every pound of nitrate nitrogen leached, either 0.7 of a pound of calcium (the active principle of lime), or 0.8 of a pound of magnesium, or 2.8 pounds of potassium are also lost, or equivalent proportions of all three.

It is therefore clear that green-manuring in this Colony must lead to considerable losses of available lime and potash from our soils. These can be largely avoided by the composting of the top-growth, and early planting of the following crop so that the latter will be in a position to utilise the nitrates as they are formed in the soil, before they can be leached away.

Again, it often happens that the ploughing under of the sunnhemp crop is unduly delayed by heavy rains, so that much of it is too mature to exert the best effects on the following maize crop.

The writer has frequently seen large areas of sunnhemp being ploughed under when almost mature. In such cases unsatisfactory results on the following maize crop may occur owing to (*a*) temporary nitrogen starvation of the young maize; (*b*) an excessively open seed-bed causing the soil to dry out unduly during the dry spells, and making it difficult for the roots of the young maize plants to obtain their food supplies; (*c*) phosphate starvation of the young maize owing to its temporary immobilisation by the micro-organisms carrying out the rotting of the sunnhemp; possibly also (*d*) shortage of oxygen in the soil for the same reasons mentioned under (*c*); an inferior stand of maize due to unrotted material interfering with planting.

These ill-effects are obviously absent when a sunnhemp stubble is ploughed up after the seasonal rains have finished, as is clearly proved by the remarkable stimulation of the

young maize, which has been always noted, under varying seasonal conditions since 1931 at the Salisbury Experiment Station, and also in the Mazoe Valley and elsewhere.

When ploughing under a large acreage of sunnhemp there must necessarily be several weeks difference in the time of ploughing under of the first and last ploughed portions of the crop, with the inevitable losses already mentioned, due to leaching of plant food or over maturity of the sunnhemp.

Some of the above losses can be partially avoided by later sowing of the sunnhemp, but this interferes seriously with farm organisation, and in any case green-manuring must remain a gamble on the weather conditions, since if later sowing is adopted the early cessation of the rains will entail a poor growth of sunnhemp.

Where the sunnhemp tops are composted, since the reaping will normally be done in dry weather and on dry soil, in the last week of March and in April, as mentioned below, all these difficulties are practically eliminated, and a much more dependable and regular manurial effect will be obtained over a period of years, than in the case of green-manuring.

SUGGESTED MODIFIED TECHNIQUE FOR COMPOSTING THE SUNNHEMP CROP.

The simple technique advised is given below followed by a more detailed explanation.

(1) Mow the sunnhemp at 18 to 20 weeks from germination.

(2) Sweep and drag it up to narrow moveable kraals on either side of the field along the headlands.

(3) Fork the sunnhemp into the kraals as fast as the cattle can keep it trampled down.

(4) When there is a depth of well trampled sunnhemp of 18 inches in the kraal, move the latter along the headlands and fill again.

(5) After moving a kraal, spread top soil from the field, and wood ashes or lime over the heap.

(6) Build the sunnhemp into heaps 9 feet broad by 3 feet high, by forking in towards the centre line from either side.

Time of Mowing.—It is recommended that the crop should be left to grow two to four weeks beyond the stage when ploughing is usually *begun*, which is about 14 weeks from germination. It is suggested that reaping should commence at 18 to 20 weeks from the date of germination. This will bring the commencement of the reaping to about the end of March, when the sunnhemp is germinated in the middle of November.

The work will therefore normally be done during April, when no more rain usually falls, and the surface soil is dry. This will facilitate the work and avoid damage to the tilth of the soil.

It is known that the woody tissue or lignin of the organic matter is the chief and most stable constituent of the humus formed by its rotting down, either in compost heaps or in the soil, and it follows that the higher the proportion of wood in the original material the greater will be the quantity of humus left after decay has ceased, and the longer will this humus and its effects last in the soil.

McChlery has shown that there is a steady increase in the fibre or woody portion of sunnhemp from 70 days from planting up to 139 days, or approximately 18 weeks, and this probably continues for several weeks more.

Therefore, by delaying cutting the sunnhemp until 18 weeks and onwards, the amount of humus produced by composting it and the persistence of its effects in the soil, will be materially increased. *It is considered that this will prove to be a very important advantage of this system of utilising the sunnhemp crop.*

It is not advisable, for various considerations as shown above, to plough under the sunnhemp at so late a stage of growth, but these objections do not apply to the composting of the crop by the technique advised here, as will be seen later.

Use of Movable Cattle Kraals.—Having mown the sunnhemp, or as soon as a portion has been mown, easily moveable cattle kraals, of a width of 16 feet, and a convenient length, are erected on the headlands of the fields on either side.

The sunnhemp is then gathered by hay sweeps into cocks of a convenient size, and these cocks, several at a time, are drawn by hay drags up to the side of the kraals and dumped. From these dumps the sunnhemp is forked over the side of the kraals and spread over the floor until about 18 inches deep. Cattle are then placed in the kraals, and as fast as they can trample down the sunnhemp under foot it is daily forked over into the kraals.

When the sunnhemp has been trampled down to a depth of about 18 inches, and sufficiently broken up and impregnated with urine and dung, the kraal is then moved along the headland and the process repeated until the whole field of sunnhemp has been dealt with.

The types of implements suggested for this work are illustrated, and instructions for making two of them cheaply on the farm are given in the Appendix.

Subsequent Treatment of Sunnhemp.—As soon as a kraal has been moved, the heap of sunnhemp and dung may be treated thereafter as compost. Soil from the adjoining field is spread over the heap with a little wood ashes or lime, in the amounts advised in Section I.; half the required quantities being used. The heaps are then built up into the standard size of 9 feet broad by 3 to 3½ feet high, by forking in the sunnhemp from either side towards the centre line. Finally the remaining half of the soil and wood ashes or lime are spread over the surface of the heap, which is now left to await the next season's rains.

This first turning of the heap, and the first turn after rain has wetted the heap the following spring, present the only difficulty in the process, and this can be largely solved by the use of manure drag-forks. With these the tightly matted mass can be torn apart when ordinary garden forks can then be used to finish the work.

It is better if when making the first turn the materials when forked in towards the centre are also moved 6 feet forward at the same time. By working thus the centre portion of the heap is also turned, and this tends to prevent the loss

of nitrogen by denitrification which may take place if the centre portion of the heap is left undisturbed in a compacted condition.

Success Depends on the Growth of the Sunnhemp.—It is clear that the economy of composting the sunnhemp crop instead of ploughing it in will be dependent to a large extent on the proper growth of the sunnhemp, and to ensure this on soil of low fertility it will be necessary to apply fertiliser to the sunnhemp, and potash may be required as well as phosphates. It must be pointed out that this would be necessary under such conditions whether the sunnhemp is ploughed in or composted.

In extreme cases of soil exhaustion legumes such as sunnhemp, velvet beans and cowpeas may not be able to obtain their own supply of nitrogen from the air, although they receive phosphates and potash. This is due to the fact that the legume bacteria are unable to work in conjunction with legumes when the organic matter in the soil is very deficient.

In such circumstances it may be necessary to plough in a grass type of crop grown on a dressing of a complete fertiliser. A suitable grass crop such as Rhodesian Sudan grass has a stronger root system than most legumes which is better able to forage for food in exhausted soils, and with the aid of fertilisers will be able to make sufficient top-growth which, on ploughing under, will add enough organic matter to the soil to make it possible thereafter for the legume bacteria to again work in conjunction with the legume and supply the latter with nitrogen.

Such a shortage of organic matter in the soil undoubtedly explains some of the cases reported by farmers from time to time of the absence of bacterial nodules on leguminous crops.

Hastening the Process for Dressing of Winter Crops such as Wheat.—If some of the compost is urgently required for winter crops the same year, the sunnhemp can be cut and composted a month or six weeks earlier when, if three turns are given at intervals of ten days to a fortnight (on rainy days if possible) the compost should be ready for applying to the land about two months later. It may be necessary, in order to ensure this, to increase the number of cattle in the kraal

or the time they are kept in the kraal, so as to crush the sunnhemp stalks more thoroughly, and to increase the nitrogen and moisture content of the compost by increased quantities of dung and urine.

However, since the sunnhemp itself will have a high content of nitrogen and contain less woody tissue when cut at this stage of growth (12 to 14 weeks) the question of the rapidity with which it will rot will be largely dependent on the rainfall during March, the extent to which the sunnhemp is crushed by the oxen, and the frequency of turning the heaps.

It will be best, for this purpose, to leave the sunnhemp undisturbed after moving the kraal until a good shower has fallen, since the wide shallow heap will ensure much more rapid and thorough wetting of the heap by the rain.

Hastening the manufacture of the compost in this way is, of course, wasteful, since a reduced quantity of humus is obtained, and this humus will not last so long in the soil. It is also wasteful of the dung and urine. It may be justified, however, where the compost is applied to irrigated crops.

Economy of Land on Small Farms.—On the smaller farms where economy of land is of particular importance, the composting of the green-manure crop will be of particular value, since only one-sixth or one-eighth of the land need then be idle under green-manure instead of a third or a quarter.

For the same reason, on small farms, at the first turn of the heap after moving the kraals, the inner half may be folded over on to the outer half. This will mean that a strip of land only 9 feet wide will be occupied by the compost heaps, but the amount of hand labour will, of course, be slightly increased.

Alternative System of Composting Sunnhemp.—An alternative system which could be employed is to keep the normal proportion of land under sunnhemp. In the example already considered two hundred out of six hundred acres would be composted, and the compost applied to another hundred acres

of land. In this way two-thirds of the land, or in this case 400 acres out of 600 acres, would receive a dressing of organic manure each year—every acre growing crops, in fact.

By adopting this system the humus content of the soil could be more rapidly built up to the economic level, and a change over to the other system be made after, say, two or three years.

This system might be more suitable for a farm which has been badly overworked and the soil denuded of humus. In such a case the sunnhemp would possibly require fertiliser to ensure a good crop. It is not considered, however, that this system would be so profitable for normal use as the other, owing to the larger proportion of unproductive land under sunnhemp each year. The writer, nevertheless, reserves the right to change his mind on this point, since there is a possibility that the higher humus content of the soil, which should be maintained by this system might, by giving higher yields per acre, more than counter-balance the disadvantage of having a smaller area under crops each year.

Sunnhemp Compost or Kraal Manure for Vlei Wheat.—The writer has already urged the wheat farmers growing wheat on the sandy vleis of the Colony to grow sunnhemp on their dry lands during summer for conversion into compost, or kraal manure.

The simplicity, economy, and great value of this have been proved conclusively by several farmers.

It has been found possible to cut sunnhemp and convert it into well rotted kraal manure of very high quality in time to apply to wheat the same year.

It may interest wheat farmers to know that 14 acres of wheat dressed with sunnhemp kraal manure in 1936 gave an average yield of 13 bags per acre. No fertiliser was applied.

So simple, inexpensive, and effective is this system of manufacturing the vlei wheat-grower's chief need, namely, organic manure, that it is again strongly urged that wheat farmers, particularly on the sandy vlei lands of the Colony, should adopt it without delay and grow sunnhemp on their dry lands for turning into compost or manure.

The writer is at a loss to understand why this system has not already been widely adopted. The only objection to it so far raised by farmers, of which he is aware, is that sunnhemp will not grow on their dry lands without fertiliser: If this is true, then farmers are strongly advised to apply a dressing of 130 lbs. of rock phosphate and 20 lbs. of muriate of potash per acre to the soil before sowing the sunnhemp. The cash price of this f.o.r. Salisbury is 9s. per acre. Only half the acreage of the wet land under wheat need be sown to sunnhemp (on the dry lands), since one acre of sunnhemp should yield at least 6 to 8 tons of manure, the effect of which should last for at least two years in wet vlei soil, since the soil conditions in these wet vleis lead to much slower destruction of humus than on dry well-drained soils, owing to the lower temperatures and the water-logged conditions.

If the sunnhemp is grown in the second year on the first year's stubble this, with the residue of fertiliser, will give a second good crop of sunnhemp.

Therefore the cost of the fertiliser f.o.r. Salisbury per acre of wheat to which the sunnhemp manure is applied would be a quarter of 9s. per acre per annum, or 2s. 3d.

The cost of the sunnhemp seed at 33 lbs. per acre (Somerset variety), if grown on the farm, should not exceed 1s. 6d. per acre of *wheat* grown.

For this outlay of 3s. 9d. per acre of wheat grown, plus the cost of carriage on the fertiliser to the farm, should give an increased yield of wheat of at least fifty per cent., and probably 100 per cent., or more. Therefore even where the average yield of wheat per acre is only 2 bags, a handsome profit is assured.

Use of Compost on Winter Crops.—A Warning.—A word of warning is necessary here with regard to the application of compost, however made, to winter-grown crops. It is particularly necessary to ensure that the compost is thoroughly rotted before ploughing it in. If rotting is not complete there is a danger of nitrogen starvation of the crops whilst the rotting process is completed in the soil. One farmer has unfortunately experienced this ill-effect on his wheat crop in the 1938 season. It is probable that this is due to the low

soil temperatures obtaining during the winter on irrigated or moisture-retaining soil, and the lack of opportunity to aerate the soil by cultivation in the case of cereal crops. These conditions reduce the activity of the nitrifying bacteria in the soil.

There is not the same danger in connection with the growing of irrigated potatoes which receive the usual heavy dressing of 600 to 800 lbs. per acre of complete fertiliser, since the nitrogen in the fertiliser tends to correct the temporary nitrogen shortage in the soil. It may be mentioned in this connection that the farmer just mentioned who experienced the ill-effect of unripe compost on his wheat, found nothing but good effects where the same compost was applied to his irrigated potatoes, which received also a heavy dressing of double potato fertiliser.

Nevertheless, it is advisable to apply only ripe compost to the potato crop, since this will ensure that they are not checked in their early growth.

Sunflowers instead of Sunnhemp.—Sunflowers can be used instead of sunnhemp, but the latter is advised wherever possible. Sunflowers should be seeded at the rate of at least 45 lbs. per acre, and cut when the flowers are just out, or earlier if speed is essential. It is possible that a mixture of the two crops may give better break down of the compost than either of these crops alone.

SECTION IV.

THE MECHANISM OF THE DECAY OF CROP RESIDUES IN THE SOIL AND IN THE COMPOST HEAP AND ITS PRACTICAL APPLICATIONS.

The density of the micro-organic population of the soil is so great that the figures are almost beyond the mental grasp of the average person. For instance, during a period of high activity in a fertile soil one ounce of soil may contain 140,000,000,000 bacteria, besides the other types of micro-organisms, which may amount to another 31,000,000. The weight of the above numbers of bacteria in the top six inches of an acre of soil would approximate to 3.75 tons. They contain approximately 10 per cent. of nitrogen.

Their numbers are constantly fluctuating, depending on the factors affecting their growth; that is the supply of air, moisture and food, the temperature of the soil, the acidity or otherwise of the soil, and the numbers present of their natural enemies which feed on them. (The amoebae in the case of bacteria.)

Their food supply consists of the plant and animal residues in the soil, and carbon dioxide and mineral salts, such as phosphates and nitrates.

In the compost heap it is certain types of these microbes, which are supplied chiefly by the added soil, which use the crop residues and dung as their food supply, and break the former down during the rotting process.

Plant residues consist chiefly of carbohydrate materials such as celluloses, hemicelluloses, and lignins. The celluloses and hemicelluloses make up the softer tissues of the cell walls of the plant, and the lignins are the chief constituent of the woody or fibrous tissues, and the hardened portion of the cell walls.

The celluloses, and a portion of the hemicelluloses, are easily and rapidly broken down by the fungi and bacteria, which use them as sources of energy and food. Some of the carbon is built up into their body tissues, and the remainder, the greater part, they respire as the gas carbon dioxide.

Microbes have no mouths by which they can feed and have to absorb their food in solution through their "skins." They therefore bring their insoluble food into a soluble form by means of digestive ferments which they excrete. These ferments readily attack the starch and celluloses, and some of the proteins in the plant residues; but the lignins or woody portions are very resistant.

The proteins, in which form the nitrogen in the crop residues chiefly exists, are broken down into simpler nitrogen compounds; part is built up again into the insoluble body protein of the micro-organisms, and part is converted into ammonia. The micro-organisms themselves contain much nitrogen; the bacteria, for instance, contain ten per cent.; and whilst they are alive this nitrogen is temperarily unavailable to crops. When the micro-organisms die on the comple-

tion of the rotting, owing to lack of food, and the compost is ploughed into the soil, as soon as the soil becomes moistened other bacteria feed on them and convert the protein in their dead bodies into the soluble (nitrate) form of nitrogen, which is at once available to crops.

SOME PRACTICAL CONSIDERATIONS.

The Modern Conception of Humus.—The modern conception of humus in its simplest form is that it is largely a combination of plant lignin or woody tissue, and proteins; the latter synthesised by the micro-organisms. It also contains some residual hemicelluloses from the plant materials, and some synthesised by the microbes. It is therefore clear that the greater the proportion of lignin (wood or fibre) in the original crop residues of the compost heap, the greater will be the weight of humus left when rotting is finished.

Another constituent of the humus is a proportion of the hemicelluloses; the celluloses having completely disappeared. These hemicelluloses are not so resistant to further change as the lignin portion of the humus.

Now humus is not a constant, imperishable substance, it is a stage in the decomposition of the organic matter (crop residues), and when compost is added to the soil the humus undergoes further more or less rapid disintegration, according to the conditions existing in the soil. Some types of lignin, too, are more resistant to further chemical or microbiological change than others. The destruction of humus is a very much slower process, of course, than that of its formation by the decay of organic matter. Its destruction may take several years, whilst its production may only occupy as many months.

Now the more mature is any plant material, such as sunnhemp, the greater is the proportion of lignin or wood and fibre in it, and therefore the greater is the proportion of humus left after composting it, and the longer should the effect of that humus last in the soil.

This is a matter of considerable importance to the farmer who is composting his sunnhemp instead of ploughing it in, since it means that the maturity of the crop when he reaps it will greatly affect both the quantity and lasting power of the humus made from it.

Minimum Nitrogen Content Required by Micro-organisms.— The rapidity of the decomposition of such plant materials in the compost heap is largely regulated by the percentage of nitrogen it contains, or which is added in the form of dung or urine. If the percentage of nitrogen in the plant material such as sunnhemp is less than 1.7 per cent. of the dry matter, the organisms which decompose it must have an added supply of nitrogen in the form of dung or urine to ensure rapid decomposition. A shortage of nitrogen will slow down the process, though it will still be completed, even though the original materials contain only a small percentage of nitrogen. The reason for this being possible is that the microbes commencing the process cease work and die when the nitrogen supply is exhausted owing to lack of food. Other bacteria then use the nitrogen in their dead tissues as a food supply to enable them to break down more of the carbohydrate material. They in turn die owing to shortage of nitrogen, and other bacteria use the nitrogen in their dead bodies and so on, until all the organic matter has been rotted down.

The nitrogen percentage in any crop falls as the crop matures, and it is therefore evident that the more mature the sunnhemp is at reaping time, when it is composted, the longer will the cattle have to be kept on it to supply the deficiency of nitrogen by their dung and urine.

The farmer can only find this out by experience, but if he commences reaping the sunnhemp at 18 weeks from germination he will not have to keep the cattle on the sunnhemp for an undue length of time.

McChlery found that sunnhemp at 18 weeks from maturity may contain 1.50 to 1.90 per cent. of nitrogen, according to the season in which it was grown; in one case a deficiency, in the other an excess, for rapid decomposition. In one year, 1933-34, it contained 1.5 per cent. of nitrogen at 20 weeks from germination.

In composting the sunnhemp crop by the method suggested above, another factor to be considered in deciding on the length of time to keep the cattle on the sunnhemp in the kraals, is the time it takes the cattle to crush the stems sufficiently.

This question affects not only the rate of decomposition, but also the ease of the subsequent handling of the materials as compost, when turning the heaps. A little experience will soon provide the farmer with this information. It is also important from the point of view of speeding up the rotting process, since the crushing of the stems assists the fungi and bacteria to make entry rapidly, and exposes a far greater area of surface of the materials for them to work on.

For the reasons outlined above it will be found that unbroken stalks of sunflower and maize are very slow to break down in the compost heap, and it is advised that such materials should be placed under cattle to be crushed before being put into the compost heap, or better still, mixed with the sunnhemp where this being composted on the land instead of being turned under.

SECTION V.

THE PLACE OF COMPOST IN RHODESIAN AGRICULTURE.

Until the middle of last century farmyard manure was practically the only fertiliser employed in Western agriculture.

During the last century Liebig announced his theory that the mineral constituents of plants supplied all that was necessary for their growth. Later the historic work of Lawes and Gilbert at Rothamsted showed that Liebig's view was only partly true, but at the same time it greatly stimulated the use of artificial inorganic fertilisers to such an extent that the benefits to be obtained from organic manures, and the necessity for their use to maintain the humus supply in the soil, came to be in danger of being lost sight of.

Latterly, however, the increase in our knowledge of the functions and properties of humus in the soil, due to the great extension of research directed on this subject, has caused the pendulum of agricultural opinion to swing in the other direction.

The rapid depletion of the organic matter in the soils of the large sub-tropical and tropical areas brought under cultivation by the white races during the last century, and

the disastrous effects of this on the physical condition and therefore on the fertility of the soils,, has helped to focus the attention of agriculturists and scientists on the great necessity for the proper and regular replenishment of the supply of humus in the soil.

Under the extensive system of agriculture largely adopted in these tropical and sub-tropical areas such as this Colony, the balance of nature has been upset, that is the balance between the natural supply to the soil of humus-forming organic material such as the leaves and root systems of trees and grasses, and its consumption or dissipation by the micro-organic population of the soil. The cultivation of the soil has slowed down the former and greatly speeded up the latter. The rate of consumption of humus in the sub tropical soils by the micro-organisms concerned is very much greater than in temperate climates owing to the much higher temperatures favouring their activity.

It has been shown by Mohr that above an average temperature of 77.2° F. no accumulation of humus can take place in a well-drained and well-aerated soil. During our summer the soil temperature often exceeds 77° F. in the greater part of the cultivated areas.

This is the explanation of the much more rapid loss of humus from our soils, when under cultivation, than takes place under the temperate conditions of Europe.

The extensive system of agriculture still employed in the Colony has greatly limited the quantity of farm manure made. The use of this, and short and long term pastures, are the chief means employed in European agriculture to maintain the humus supply of the soil, but their employment in this Colony is only possible to a very limited extent, at present.

This urgent problem has been met in a measure by the practice of green-manuring, which fortunately fits our climatic conditions well, owing to the almost complete absence of rain during the period between cropping seasons, which tends to prevent losses of plant food from the green crop after it is ploughed in.

However, green-manuring in Rhodesia suffers from a number of inherent disadvantages as pointed out earlier, and there is a limit to the possibilities of its employment, as already mentioned in detail. The writer is of the opinion that many of these disadvantages can be overcome by composting the top-growth of the green-manure crop, where this is sunnhemp.

The supply of organic manure can also be greatly increased by turning all the residues from the maize, wheat and barley and other crops into compost. Their conversion into kraal manure should be discontinued in favour of composting, since the former process is very wasteful, and also insanitary, both from the point of view of crops and human beings.

It may be mentioned here that compost made from crop residues, chiefly maize wastes, has given remarkable results when applied to the cotton crop in this Colony. *Peat found at Gatooma that an application of five tons (short) per acre of compost gave an increase in the yield of seed cotton of 80 per cent. over the untreated cotton. The untreated cotton yielded 500 lbs. per acre of seed cotton, whilst the cotton receiving 5 tons per acre of compost, yielded 900 lbs. of seed cotton per acre. It seems probable, from the facts published, that one important reason for such striking results being obtained is that the compost materially aided the cotton to resist the effects of the serious drought of five weeks during February and March. Such droughts are always to be expected in this Colony, and the drought resistance which humus in the form of compost can confer on crops when applied to the soil is one of the weightiest arguments for its greater employment in our agriculture.

The amount of compost which can be made is limited by the supply of raw materials, and of animal dung. Besides crop residues, however, there is much raw material not yet utilised in the shape of old veld grass, reeds from the river-sides and streams. Also, there is a great quantity of grass cut on the sides of roads each year and wasted. The small awkwardly-shaped valleys in the hills could profitably be

*J. E. Peat. Notes from the Cotton Station, Gatooma, 1937. Rho. Agric. Jour., Oct., 1937.

which received compost made from sunnhemp tops. Note drought resistance due to compost

Maize following sunnhemp burnt on the land. Note severe drought effect and compare with above photograph. Both plots planted same date, and photographed same date.

Rotational System H Maize after green manure ploughed under plus 200 lbs per acre superphosphate Compare with maize which received farmyard manure in System F and note the healthier growth on this plot

Rotational System F Maize plus farmyard manure. The manurial treatment had very little effect on the yield of maize

planted to a permanent crop such as Napier fodder to increase the supply of organic material and at the same time serve as fodder resevres.

Sunnhemp the Main Source of Cheap Raw Material.—However, the main source of cheap raw material at present is the top-growth of the sunnhemp crop, and the composting of this on the lines suggested, simplifies and cheapens the production of compost, by eliminating most of the expense of collection and carting of the raw materials, and most of the hand-labour.

It is perhaps pertinent here, in order to gain some idea of the very great possibilities of the system to estimate its potential advantages to the farming industry as a whole, on the basis of the total area of land annually under green-manure at present.

This is approximately 50,000 acres, and so at least 25,000 acres of this could be released to produce crops each year, which on the basis of the estimates given above should amount to 300,000 bags of maize, if this were the crop planted.

The estimate is based on the supposition, of course, that the whole area is normally sown with sunnhemp and that it is loam soil. This is not so, of course, but it serves to illustrate the possible gain to the farming industry by a change to the system suggested.

KRAAL MANURE *versus* COMPOST.

Until the introduction of the modified Indore composting method of producing organic manure or humus with rain as the only source of water supply, the making of kraal or farm-yard manure was the only cheap practicable method of utilising crop residues and waste organic matter, which had found favour in this Colony. The defects of the process were, since there was no suitable alternative, ignored, and its virtues only were extolled. Because of this many farmers have difficulty now in appreciating why the making of kraal manure is condemned as a wasteful and insanitary process, and the making of compost is advised in its place, whenever this is economically possible.

A comparison of kraal manure with compost may be briefly summarised thus:—

Kraal Manure.	Compost.
1. Crop diseases and pests not destroyed, and maize wastes therefore cannot be safely placed in kraals.	1. Destroyed by high temperatures, except, possibly, for certain tobacco diseases.
2. Weed seeds not killed.	2. Weed seeds killed.
3. Losses of nitrogen may exceed 78 per cent., during making and application to soil.	3. Gains of 4 to 26 per cent. of nitrogen made from air, during making; losses during application negligible.
4. Losses of potash may exceed 50 per cent.	4. Losses of potash much reduced.
5. In seasons with cold and wet commencement crops do not respond to kraal manure owing probably to the slow availability of the nitrogen content.	5. Plant foods in compost rapidly available, and crops respond to it even in cold and wet seasons such as that of 1937-38.
6. Is very wasteful of animal dung and urine.	6. Dung utilised economically and urine partially.
7. Forms the ideal breeding ground for flies.	7. Flies cannot breed in properly made compost.

Some of the above items require further explanation.

Inefficiency of Kraal Manure in Cold Wet Seasons.—With regard to the inefficiency of kraal manure in seasons when the opening months are wet and cold it has been found in the rotation experiments at the Salisbury Experiment Station that in such seasons maize to which 8 tons of kraal manure per acre has been applied shows practically no response to the treatment. In the present season the maize dressed with kraal manure again shows little or no response to the treatment.

These facts are illustrated in the following table of yields in Rotation F., in which three-quarters of the land is under maize and one-quarter of the land is under Sudan grass reaped for hay.

	Maize plus 8 tons kraal manure per acre.	Maize following maize plus kraal manure.	**Rainfall.** December.	January.
1924-25	8.65 bags	21.75 bags	13.12 ins.	10.51 ins.
1928-29	10.15 bags	14.55 bags	5.45 ins.	11.50 ins.
1932-33	10.75 bags	9.72 bags	7.30 ins.	9.60 ins.
1934-35	6.99 bags	6.05 bags	7.66 ins.	9.60 ins.
Average yields	9.13 bags	13.01 bags		

The yields of maize are given in bags of 200 lbs. each per acre.

It will be seen that in these four years the maize following maize which received 8 tons of kraal manure the previous year, has yielded on the average about 4 bags per acre more than the maize which received a dressing of 8 tons of manure per acre.

Whatever may be the reasons for the ineffectiveness of the kraal manure in seasons in which the first two months are wet and cold, the fact that it may be largely wasted in four seasons out of 10, as shown by the results obtained on the Salisbury Experiment Station during the last 10 years, is a matter of great importance to the practical farmer, and a strong argument in favour of a change to composting as the method of humus manufacture.

It is probable that this failure of kraal manure in seasons having a cold wet opening is due to the fact that the nitrifying bacteria in the soil are unable under the cold and wet conditions to convert the organic nitrogen into the mineral, soluble form, in which form only it is available to the maize crop.

At the same time these wet cold conditions are also unfavourable to the activity of the free-living nitrogen fixing bacteria, which fix the nitrogen from the air, and so the crop cannot get its immediate requirements of nitrogen from this alternative source.

Loss of Nitrogen.—With regard to the losses of nitrogen during the making and application of kraal manure, it has been shown by research in England* and on the Continent†

*Technical Communication No. 33 of the Imperial Bureau of Soil Science. 1935 pp. 7 to 10.

†Journal of Ministry of Agriculture, Vol. XLII., No. 12; 1936, p. 1231

that even where the best methods of making and storing under cover are used that the loss of total nitrogen from bullock manure may exceed 78.3 per cent. When the dung was removed from deep stalls about 15 per cent. of the total nitrogen had already been lost. After storing in a heap under cover a further loss of up to 42 per cent. of the remaining nitrogen was lost. During exposure of the manure on the field for four days prior to ploughing it under a further 52 to 60 per cent. of the remaining nitrogen was lost.

In a field test of the manurial value of manure applied to oats, barley and turnips, it was found that "in the first year of application dung exposed for four days before being turned in was equivalent to half the same weight of manure ploughed in at once." This is largely due to the loss of nitrogen in gaseous forms.

It is interesting to speculate on how much greater these losses of nitrogen are from kraal manure made under the usual Rhodesian conditions, which could hardly be worse.

On the other hand Howard and Wad showed that during the making of Indore compost, gains of nitrogen from the air amounting to from 4.4 up to 26.3 per cent. may be made.

During storage in heaps for one month they found the losses of total nitrogen amounted to only 0.04%.

There is much evidence of the slow availability of the nitrogen in farmyard manure even under favourable conditions, and under the unfavourable conditions of long continued spells of wet weather it appears that this nitrogen never becomes available to the maize crop in time to be of use, since it must be remembered that annual crops require nitrogen chiefly in the early stages of growth.

Howard and Wad* have shown that the nitrogen in Indore compost is readily available, and the writer has seen convincing evidence in the field this season that it is readily available even under the continuous wet and cold conditions which obtained in the first two months of the growing season.

*The Waste Products of Agriculture: Howard and Wad.

Maize to which compost had been applied exhibited the normal response to nitrogen shown by the vigorous dark green growth of stems and leaves.

Waste of Dung and Urine.—In the making of kraal manure or farmyard manure, much more dung and urine are employed than are actually necessary to supply the minimum quantity of nitrogen to enable the fungi and bacteria to bring about the decay of the bedding and the crop wastes. This excess of nitrogen is almost entirely lost in gaseous forms, or is leached out by rain as nitrate. If this wasted nitrogen were properly employed in the rotting down of more crop wastes, bedding, etc., by making compost, this loss could be avoided, and much greater quantities of humus could be made on the farm for building up and maintaining the fertility of the soil. Until the introduction into this Colony of the Indore method of composting organic matter it was not possible to utilise safely the great quantities of maize wastes available each year, owing to the danger of spreading diseases and pests by converting them into kraal manure. This tremendous waste of most valuable humus-forming material may now be safely utilised in the making of compost, and at the same time much of the huge loss of nitrogen from the cattle kraals of the Colony prevented.

Destruction of Flies.—As is well known flies are one of the most important agents in carrying bacteria, and to the dairy farmer in particular they form a constant source of infection of his milk and cream, and in consequence are a constant and serious threat to the quality of these products.

Few dairy farmers require reminding of this fact, but they may not all realise that this source of loss can be largely avoided by eliminating the insanitary kraal and manure heap in favour of the compost heap.

Cattle kraals and manure heaps are the chief breeding places for flies, but these pests cannot breed in properly managed compost heaps owing to the high temperatures of the interior. It is necessary, however, to turn the heaps sufficiently and frequently to ensure that any eggs and larvae present in the cooler surface of the heaps are killed by placing the outer layers of the heap in the centre whilst turning.

Flies are also a source of loss to the farmer in that they seriously interfere with the peace and comfort of farm animals, and an animal which is not comfortable can never yield the maximum profit to the owner. It is also necessary here to point out once again that flies are one of the chief carriers of human diseases, though it is hoped that no one is now unaware of this very serious aspect of the fly nuisance.

APPENDIX.
LABOUR-SAVING IMPLEMENTS FOR COMPOSTING.

A description of two types of hay sweep, and a hay drag, which will simplify and cheapen the collection of raw materials for composting, particularly when the sunnhemp crop is composted, are given below.

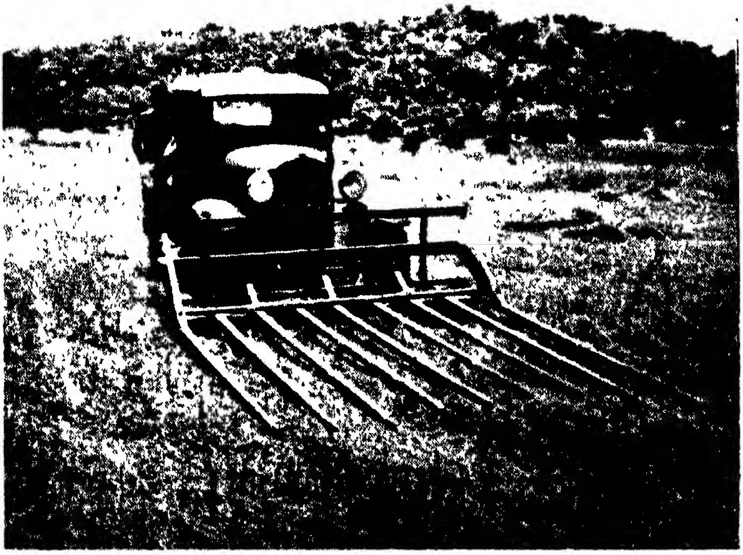
The Hosier Hay Sweep.—This implement was invented by Mr. A. J. Hosier, the pioneer of the open air milking system, and is being increasingly used by farmers in Great Britain, where it has been most successful.

The writer introduced this implement to the notice of Mr. A. S. Laurie, of Concession, who immediately appreciated its possibilities, imported one, and with his usual public spirit arranged a demonstration of its working on his farm Somerset. Unfortunately very few farmers took advantage of this opportunity to see it in action, but it clearly proved its suitability to Rhodesian conditions.

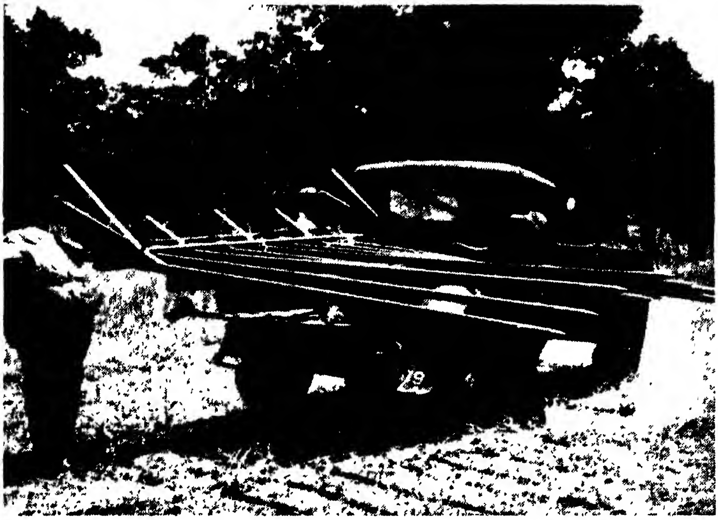
On an earlier occasion Mr. Laurie kindly gave a demonstration to the writer of its ability to sweep up a crop of sunnhemp hay, which was lying in windrows, and the accompanying photographs show it in action on this occasion. The sweep was attached to an old Ford half-ton lorry and it moved over the uneven ground and along the sides of contour ridges without difficulty and swept the sunnhemp into large loading dumps at a remarkable speed.

The writer was greatly impressed with the work done by this implement, and he can strongly recommend it for use on ordinary farm fields in this Colony in sweeping grass and sunhemp for composting or, of course, for hay.

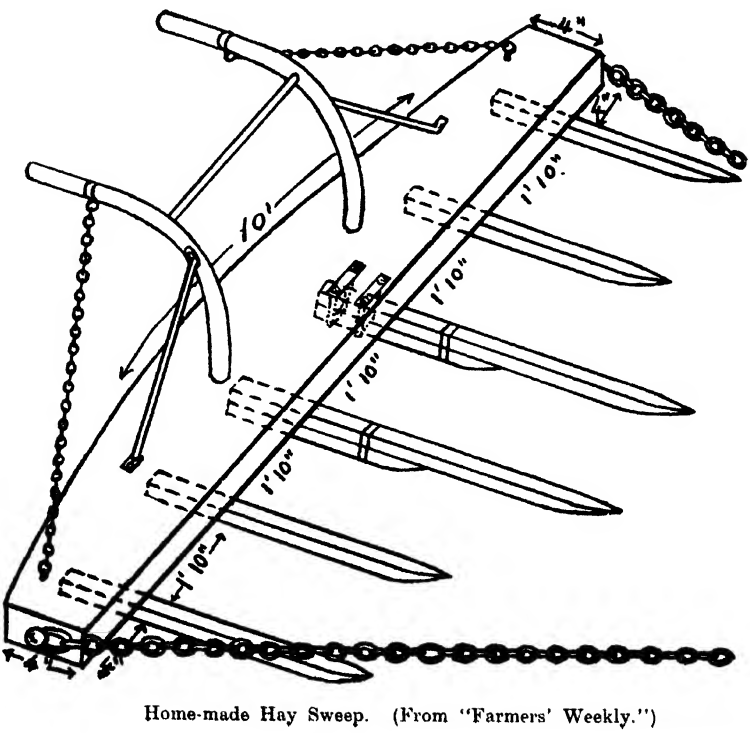
The Hosier Hay Sweep in action on Mr. A. S. Laurie's farm at Concession. A full load of sunnhemp being pushed to the loading point.



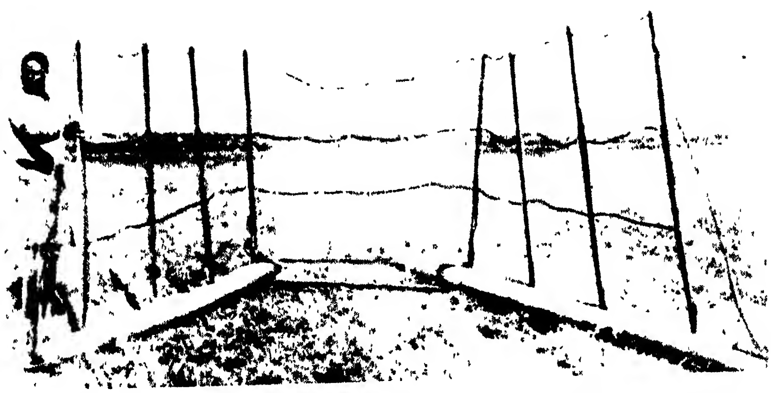
The Hosier Hay Sweep. It is attached to the dumb iron of the lorry.



The Sweep is easily removed in a few minutes for transport to another field Note shape of points, which are metal-covered



Home-made Hay Sweep. (From "Farmers' Weekly.")



Hay Drag for collecting cocks of sunnhemp

With regard to its capacity Mr. Laurie writes as follows: "As regards work done: In three and a half days of easy going the sweep easily cleaned up 60 acres of land. Ten boys were building stacks and simply could not keep pace with it, and so it had to stand still much of the time."

"I am very pleased with the work done by the sweep (much of it on rough going); it saved endless time and labour, and my anxieties regarding sufficient winter fodder for live-stock in future are a thing of the past, *and I should think for making compost it will prove just the very thing for collecting the material where and when required. No more ploughing under of sunnhemp in future, I am thinking.*"

The sweep is made in the following sizes and prices in England. The manufacturers are Messrs. Hosier Inventions, Ltd., Wexcombe, Marlborough, Wilts.

7 tines (6 feet wide) for light cars ... ... price	£5	15	0
9 tines (8 feet wide) for 16 h.p. cars... ... price	£6	10	0
11 tines (10 feet wide) for cars over 16 h.p., price	£7	10	0

The handling and forwarding charges from Beira to Concession amounted to £1 3s. 0d. Spare tines cost 5s. 6d. each.

Mr. Laurie's sweep is a 9 tine model, but he thinks that possibly a 7 tine model might be more economical under local conditions, since it would probably allow the car to be driven on a higher gear.

Not only should this sweep go far to solve the problem of economically collecting the sunnhemp crop for composting, but it should enable farmers to make better quality veld hay owing to earlier cutting being made possible when the grass has a higher feeding value, owing to the fact that advantage can be taken of short dry spells during the months of January and February.

A Home-made Ox-drawn Hay Sweep.—This type of hay sweep was illustrated in the *Farmers' Weekly* of 17th February, 1937, and the instructions for making it were given by Mr. C. J. Littleton and are quoted below. This gentleman states that it is commonly used in Scotland and Northern

England, where it is called a "Tumbling Paddy." Mr. A. Stidolph, farming near Salisbury, has had one of these sweeps made locally, and has found it of the greatest assistance in his hay making this year.

With two oxen and four natives it collected 36 acres of a good crop of veld hay into cocks in two and a half days.

Since this sweep can be made on any farm it may appeal to many farmers, and Mr. Littleton's instructions for making it are as follows. (See illustration.)

"It is made of a stout plank 10 feet or 12 feet long and 9 inches wide in the centre, tapering to 4 inches at each end, with 6 wooden teeth; the two centre ones 4 ft. 6 ins. and the outside ones 3 feet long. These are pointed and shaped as shown, so as to keep them from running into the ground. There are two handles of a half moon shape with a light chain from each handle to the end of the plank to steady the load when full.

The draught is from the ends where the light chains are attached, swivel fashion, and brought to a point where the trek chain is hooked on. The chains must be fairly long to allow for the hay banking up on the sweep, and to allow the latter to turn head over heels when emptying the load.

The teeth are fastened to the plank, as indicated, by means of U-bolts. The two centre teeth are provided with short runners underneath to take the wear, such a sweep will hold approximately half a ton of hay.

To empty the load the team is stopped and backed and the sweep is pulled back about three feet, the handles are then lifted up to stick the teeth in the ground, and the oxen are driven on, and the sweep turns over dropping its load."

A well made sweep of this type is sold in Salisbury at £5 0s. 0d.

A Hay Drag.—A simple, inexpensive, but efficient hay drag as illustrated and described in the following notes was found extremely useful at the Gwebi Government Farm when the veld hay was stacked in the same field where it was cut.

The hay was cocked in the field, and three or four of these cocks were then collected by the hy drag and drawn to the stack-side, where a derrick fitted with scissor pincers lifted the hay up on to the stack. This method of handling the hay saved a great deal of the labour and time normally employed in loading the hay on to wagons and pitching it from the wagons to the stack, and it will serve the same purposes in composting sunnhemp.

The drag consists of two wooden poles 6 to 8 inches in diameter, hinged at the rear by $\frac{3}{4}$ inch bolts to two parallel iron bars 3 feet by $\frac{3}{4}$ inch thick, and about 2 inches wide. The iron bars are bolted one above the ends of the poles and one below, the bolts passing through the iron bars and the poles. In four holes, evenly spaced along each of the poles, fencing standards of angle iron are fixed by wooden wedges. The implement is completed by three strands of barbed wire running through the holes in the fencing standards. The topmost wire of the three is carried down to the front end of each pole, and so serves as a stay wire to take the strain when a load is being moved. At the draught end of each pole an iron loop is bolted, to which the trek chains are fastened. A span of four oxen it hitched on to each beam; a leader is required for each span and one driver for the two, and an extra boy behind the drag. The latter is required to assist in guiding the drag on to the hay cocks; clearing it of hay at the stack-side; and in steadying the drag when reversing.

When picking up a load, the two teams of oxen are driven up to a hay cock and pass on either side of it, so that the latter is enclosed by the arms of the drag. When a full load has been collected it is drawn up to the stack-side and the two teams then reverse outward to either side; the drag turns inside out and the hay is released. At this point the extra boy is required to remove the hay which clings to the sides of the drag and to steady the drag as it reverses. The drag then goes off for another load.

A number of these drags are doing useful work throughout the Colony.

USEFUL FIGURES.

(1) One cubic yard contains 27 cubic feet.

(2) Two cubic yards of moist ripe compost weigh approximately one ton. Each two yards length of a heap of ripe, moist compost of the standard dimensions, 9 feet wide by 3 feet high, will therefore contain approximately 3 tons of compost.

(3) One sack has a capacity of approximately 4¾ cubic feet.

(4) Approximately 5¾ sacks of ripe moist compost weigh half a ton.

(5) One cubic foot contains approximately 6¼ gallons. Therefore 1½ petrol tins contain rather less than one cubic foot.

(6) One acre inch of rain is equivalent to 101.1 long tons of water or 22,650 gallons (approx.).

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CLEANLINESS AIDS INSECT CONTROL.

Fumigation with Hydrocyanic Acid Gas

By M. C. Mossop, M.Sc.

(Continued.)

TABLE OF CONTENTS.

DOSAGES.

On the question of dosages no hard and fast figures can be given, because of the different kinds of enclosed spaces that may be used, the variation in leakage therefrom, the purity of the chemicals, the nature and condition of the materials to be fumigated and of the enclosing walls, and other factors. However, a general guide may be given and dosages may be adjusted according to circumstances. In suggesting dosages it is assumed that an intelligent and conscientious attempt will be made to render the enclosed space reasonably gas tight.

The dosages in this article are stated in terms of the number of ounces of sodium cyanide which, with the requisite amounts of sulphuric acid and water, will give the necessary concentration of hydrocyanic acid gas when the gas is confined in a space of 1,000 cubic feet.

CONCENTRATION-TIME GUIDE—POT METHOD.

The concentration of gas during fumigation is not the only factor to be considered in an effort to obtain an effective kill. Another important factor is the time during which insects are exposed to the gas. The most effective fumigation

for killing insects is that in which the highest concentration of gas is used for the longest period. As some pests can be killed at lower concentrations, Table I. has been compiled as a guide to suggest both the amount of sodium cyanide required to produce the necessary concentration, and the time.

TABLE I.

Concentration-Time Guide for HCN Fumigation.

Pest.	Ounces of Sodium Cyanide per 1,000 cu. ft. to produce required concentration.	Hours Exposure.
In greenhouse	$\frac{1}{8}$ to $\frac{1}{2}$	$\frac{1}{2}$
Adult mosquitoes	1	$\frac{1}{4}$
Fleas	$3\frac{1}{3}$	$\frac{1}{2}$
Plants in foliage (in chamber)	3	$\frac{3}{4}$ to 1
Dormant plants (in chamber)	5	$\frac{3}{4}$ to 1
Rats and mice	5 to 7	2
Cockroaches and eggs	15	6
Lice and eggs	23	6 to 12
Bedbugs and eggs	12 to 16	4 to 8
Pests infesting mill and warehouse buildings	15 to 30	48 to 72
Clothes moth larvae	20 to 40	48 to 120
Book and furniture pests... ...	20 to 40	48 to 120
Dried fruit pests	40	24
Stored product pests in general except tobacco...	20 to 40	24 to 120
Stored Tobacco Insects:		
(*a*) infesting warehouses	20 to 40	48 to 72
(*b*) infesting factory or empty warehouses ...	15 to 30	24 to 72
(*c*) infesting bales (in chamber)...	95 to 100	48 to 96

An excess of gas or of time usually does not harm and may improve the effectiveness of fumigation, but must be avoided where living plants are being fumigated. When living plants are involved, the concentration given in Table I. should not be increased, and, in general, an exposure of 45 minutes in a fumigation chamber is advisable.

For killing vermin but not their eggs, about half the suggested amounts of gas and of time will usually be found sufficient.

Because both the construction of warehouses and the products they contain vary so greatly, the dosages suggested for warehouses are rather elastic. Exposed insects in empty warehouses can be killed by a dosage of 10 oz. of sodium cyanide if the gas is evenly diffused throughout the building. But such even distribution seldom occurs and insects are often not exposed but hidden in crevices; the dosage therefore needs to be heavier. Stored products in a warehouse will absorb some of the gas and an increased dosage should be given to allow for this. Considering the variety of conditions possible the recommendation of one exact dose would be misleading, and either wasteful or insufficient. Ordinary warehouse fumigation seldom aims at a 100% kill, but the dosages recommended above should give good control. When stored products are present, insects in these products will not be killed.

In the fumigation of tobacco in Southern Rhodesia a 100% kill is aimed at. The tobacco dosages given are therefore high. The figure 100 ounces of sodium cyanide for baled tobacco under Rhodesian conditions has been advised by the writer since 1932. Elsewhere, other writers have suggested lower dosages, but have presumably had only reasonable control in view. On the other hand, dosages equivalent to about 130 to 150 ounces of sodium cyanide per 1,000 cubic feet for 15 hours have been used in vacuum fumigation of tobacco in the United States of America. There are some who despair of obtaining a 100% kill in baled tobacco, no matter what concentration is used.

Dosages for citrus trees can be found in the appropriate literature. For animal burrows and similar spaces the trade literature on the substance to be used (usually calcium cyanide) should be consulted, but only a very general guide is usually given because the size of the enclosed space must be guessed.

EQUIVALENTS FOR OTHER THAN POT METHOD.

If one of the methods of producing HCN other than the pot method is adopted, the amount of material to use can be

calculated from the equivalents in Table II. The Table, though not necessarily highly accurate, is a sufficient guide for practical purposes. (The equivalents are based on the amount of HCN actually available for fumigation that is produced per ounce of sodium cyanide, namely, 12 grammes.)

TABLE II.

Equivalent Quantities of HCN-producing Media.

Sodium Cyanide.	Liquid HCN.	"Zyklon."	Calcium Cyanide e.g., "Cyanogas."	Calcium Cyanide e.g., "Calcid."
1 oz.	18 cc.	$\frac{3}{7}$ "oz."*	$1\frac{3}{4}$ oz.	$1\frac{1}{4}$ 20-gm. briquettes.
9.5 oz.	171 cc.	1 "4 oz." tin	16 oz.	$11\frac{1}{2}$ 20-gm. briquettes.
95 oz.	1710 cc.	1 "40 oz." tin	160 oz.	114 20-gm. briquettes.

*When dealing with "Zyklon" the material should not be weighed out. An "ounce" refers to the *weight of HCN* to be produced by materials weighing about two and a half ounces. For instance, a "four-ounce" tin will produce four ounces of HCN, although its gross weight is about twelve ounces. It cannot conveniently be subdivided with accuracy unless specially calibrated apparatus is used.

VENTILATION.

After fumigation the chamber, room, house, or warehouse must be thoroughly ventilated before re-occupation. For the ventilation of large structures it may be necessary to effect an entrance in order to open the windows, and in this case experienced fumigators equipped with gas masks should be employed.

Smaller structures, in which windows and doors have been closed in such a way that they can be opened from the outside, can be ventilated without the use of gas masks, but due care should be exercised not to breathe the escaping gas, nor to subject others to its dangers.

On a still, humid day several hours of ventilation will probably be necessary, but on a windy day sometimes as little as half an hour may be enough, provided the ventilation facilities are unusually good and the doors and windows are

left open after re-occupation. Bedding, upholstered furniture and bags or bales of products retain a certain amount of absorbed HCN and give it off slowly after fumigation. Therefore if the windows and doors are closed an increasing amount of gas collects in the enclosed atmosphere. Hence buildings should be left open for several hours after fumigation. Mattresses and blankets should be well shaken and aired in the open if they are to be used within a few hours of fumigation. Young children and invalids should not be permitted to sleep in a room that has been fumigated the same day, but it is safe enough for healthy adults, provided the windows and, if possible, the doors are left open, and the smell of the gas has almost disappeared.

A more scientific method of deciding whether a room can be occupied is the use of the benzidine copper acetate test. The test is described in the "Zyklon" booklet already referred to, and is applied *after doors and windows have been re-closed for about twenty minutes.* The following is quoted almost word for word from the booklet:—

(1) 2.86 gms. copper acetate per litre of water.

(2) 475 c.c. saturated benzidine acetate solution with 525 c.c. of water.

(3) Mix equal parts of (1) and (2) just before using.

Slips of white filter paper are dipped into this re-agent and taken into the space to be tested, in closed test tubes. Upon exposure the paper will show from a faint blue to an intense blue, the depth of colour depending on the quantity of gas present.

If mixtures (1) and (2) are each diluted with equal parts of water before mixing, a slip of dipped filter paper will change to a faint blue colour in 10 seconds in a concentration of approximately one part of HCN in 13,000 parts of air.

The dipped test papers are so very sensitive to the gas that even a faint trace of HCN will very slightly discolour the paper after prolonged exposure. If, however, no colour change takes place in ten seconds, the room may be considered safe for re-occupation, *provided windows remain open all night.*

Complete testing sets, ready for use, can be made up and despatched to customers at short notice. Ready-made sets are not stocked, because it is better that the ingredients should be freshly prepared.

DISPOSAL OF RESIDUE.

The residue left after a fumigation by the pot method has been carried out should be handled with care. The chemical action may not be complete owing to the use of lumps of sodium cyanide that are too large for the depth of the liquid, or to the use of insufficient water. Or the shape or quality of the paper bags may be responsible for the same results. Whatever the cause, it sometimes happens that when a vessel is disturbed after fumigation, reaction recommences and hydrogen cyanide gas is evolved. After ventilation, therefore, each vessel should be examined to discover whether the reaction is complete. As the room should normally be vacated for safety as soon as the reaction recommences in any one vessel, if more than one vessel has been in use gas masks should be worn, otherwise it may be necessary to visit and re-ventilate the room several times before all vessels have been checked up. After it has been ascertained that a complete reaction has occurred in all the vessels, the contents can be emptied into a hole in the ground and covered with soil. The ground will not be permanently poisoned.

The residue, if any, usually lime or Kieselguhr, after fumigating methods other than the pot method have been used can be swept up and buried, spread over a temporarily vacant garden bed and dug in, or mixed with the compost heap.

GAS MASKS.

Gas masks should be used whenever it is necessary to enter an atmosphere that is charged with HCN. Moreover, they should be on hand in case an unforeseen entrance becomes necessary. The best type is that which fits over the whole face and has a gas absorbing cannister attached. Unless the previous history of the cannister is known and approved, a new one should be used. A perfect fit, and fresh and correct absorbents should always be insisted upon.

The protection afforded by gas masks is against the breathing of HCN gas. Poisoning by absorption through the skin may also occur, and the danger is greater when dosages are heavier. But it should be borne in mind that gas masks do not afford perfect protection even again breathing the gas. If the best type of mask is obtained and the makers' directions

are followed intelligently and in detail at all times, it makes fumigation reasonably safe. Nevertheless, the possession of gas masks must not be allowed to lead to carelessness. They may be likened to a combination of chemical and mechanical safety valves, and sometimes safety valves do not function properly.

FIRST AID METHODS.

The action of cyanide on humans is so rapid that first aid may be found to be the last aid a patient will ever need. Every precaution should therefore be taken to prevent the occurrence of accidents, and to know at once what to do if one does occur. The terrible feeling of helplessness and incompetency one feels when a colleague is laid out on the ground can to some extent be avoided by a knowledge of the correct procedure under the circumstances.

Accidents fall into two main types, namely, accidents due to ingestion, or swallowing cyanide, and accidents due to inhaling the gas or absorbing some form of cyanide through the skin. Advice given by different writers is not always the same, and that which follows has been kindly selected by the Medical Director and the staff of the Public Health Department from the publications mentioned.

ACCIDENTS DUE TO INGESTED CYANIDE.

The following is quoted from "The 'Zyklon' Process of Fumigation" issued by the South African Fumigation Company (Pty.) Ltd., and is designed for cases in which cyanide in solid or liquid form, or in solution, has been swallowed:—

> (1) Give at once a freshly prepared mixture consisting of 30 c.c. of a 23% solution of ferrous sulphate and 30 c.c. of a 5% solution of potassium hydrate, to which should be added two grammes of powdered light oxide of magnesia.
>
> (2) After the above mixture, give a large draught of hot water and endeavour to get the patient to vomit by an emetic or by tickling the back of the throat.

The above chemicals should be purchased in the *required quantities* so that they can be mixed immediately without recourse to measuring. They should be kept apart, but in

one container on which the instructions are clearly written in ink. Possibilities of delay should be eliminated.

ACCIDENTS DUE TO INHALATION OR ABSORPTION OF CYANIDE.

The following is reprinted from "Liquid HCN for Citrus Fumigation" issued by the Agricultural Advisory Department of Messrs. African Explosives and Industries, Ltd., and is designed for cases in which the gas has been inhaled or the liquid or soluble form has been absorbed through the skin. Absorption through the skin may occur through exposure to heavy concentration of the gas, or through handling the liquid or solid form of cyanide or substances impregnated with HCN, *e.g.*, "Zyklon."

> Hydrocyanic acid is extremely poisonous to humans in that it paralyses the respiratory system, and brings about internal suffocation. The toxic effect of HCN depends on its concentration; a high concentration may be fatal rapidly, but a lower concentration only after a longer time. HCN absorbed, less than the lethal dose, is eliminated from the system so that very low concentration can be tolerated indefinitely; chronic HCN poisoning is not observed.
>
> On account of the lightness of HCN and rapidity with which it disperses, high concentrations are seldom encountered *in open air citrus tree fumigation.* When fumigating closed spaces such as houses, ships, etc., one cannot be too careful. Moreover, accidents may happen even in citrus fumigation in the open, and it is just as well to be prepared. Poisoning from liquid HCN may be due to:—
>
> (1) Inhalation of the gas produced by evaporation of the liquid.
>
> (2) Absorption of HCN through the skin either as a result of splashing by the liquid or prolonged exposure to the strong gas.
>
> A man entering an atmosphere containing a weak concentration of HCN will be warned of the onset of HCN poisoning by the symptoms described below, and *at the first sign of any of these symptoms he must leave the dangerous atmosphere.* The action of HCN in high concentration may, however, be so sudden that a man entering such an atmosphere will collapse before he has time to act on any warning he receives. The early warning symptoms of poisoning are:—
>
> (a) Sensation of irritation in the throat.
>
> (b) Increasing difficulty in breathing.

(c) Watering of the eyes.

With a larger dose the above-mentioned symptoms may be followed rapidly by:—

(d) General weakness and heaviness in arms and legs.

(e) Headache, dizziness, nausea, vomiting.

(f) Pallor and signs of increasing shock.

(g) Unconsciousness.

(h) Cessation of breathing.

First Aid Instructions (for Inhalation or Absorption).

The following treatment must be applied with the *greatest promptitude*:—

(i) Remove patient to a pure atmosphere.

(ii) Place him in a recumbent position with the head to windward. *Do not in any circumstances walk him about.*

(iii) If breathing shows signs of failing or has ceased, apply artificial respiration (Schafer's method) and *continue without interruption.*

(iv) Amyl nitrite should be administered by inhalation immediately after poisoning for 3 to 5 minutes—15 to 30 seconds at a time. At the same time a subcutaneous or intra-muscular injection of lobeline hydrochloride should be given.

(v) Cut away any clothing splashed with HCN.

(vi) If possible, summon a doctor immediately the alarm is given.

First aid outfits for fumigators containing 2 capsules of amyl nitrite and 1 hypodermic capsule of lobeline hydrochloride can be obtained from Messrs. B. Owen Jones, Ltd., P.O. Box 2933, Johannesburg, at 5s. 6d. each. Both drugs will keep indefinitely if unopened. In addition, a bottle of ammonia is frequently very useful, for with cases of slight dizziness the patient can inhale these fumes.

The amyl nitrite capsules consist of a small glass capsule wrapped round with cotton wool. The capsule is simply snapped in the fingers, when the amyl nitrite is absorbed in the cotton wool. The broken capsule is held close to the nose, and vapours are given off which are inhaled. Amyl

nitrite has the effect of dilating the blood vessels. Amyl nitrite should not be administered for longer than 15 to 30 seconds at a time, since continuous inhalation of the drug is dangerous.

The hypodermic capsule of lobeline hydrochloride consists of a pliable container for holding the drug. Attached to this container is a hypodermic needle covered with a glass protector. A small stylet which passes down the needle and prevents leakage is sealed to the top of the glass protector. To administer this drug one simply tears off the metal strip at the base of the protector and removes it, which at the same time draws the stylet from the needle. The capsule is then held at the stiff part, the skin on the forearm pinched up and the needle inserted. The pliable container is then squeezed to inject the dose. The injection can also be given intramuscularly in a fleshy part of the body. Lobeline hydrochloride is a powerful heart stimulant.

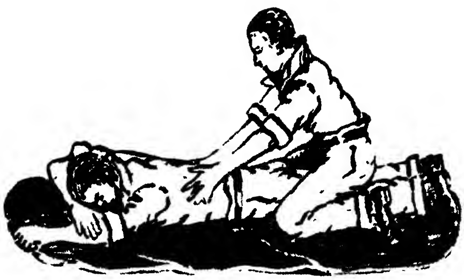
These drugs are used regularly on the gold mines, and anyone—including intelligent natives—can be taught to use them.

Schafer's Method of Artificial Respiration.

Lay the patient on his belly with his face to one side so that his nose and mouth are free for breathing. See that the tongue or false teeth have not fallen back. Place one arm straight out beyond the head and the other under the forehead, as shown in the figures (Fig. 2). Kneel, straddling the patient's thighs and facing his head, rest the palms of the hands on his loins with the thumbs nearly touching each other and fingers spread over the lowest ribs, as in position 1. With arms held straight, swing slowly forward so that the weight of your body is gradually, not *violently*, brought to bear upon the patient, as in position 2. Then, leaving the hands in place, swing backwards slowly so as to remove the pressure—thus returning to the first position. Repeat deliberately 16 to 20 times per minute, swinging forward and backward. Continue this process without interruption until natural breathing is restored or until the doctor arrives. Keep the patient warm by whatever means are available. Do not give any liquid by mouth until the patient is fully conscious.

PRECAUTIONS.

A few hints on "safety first" precautions constitute an important feature of any article of this nature. In this connection no excuse is offered for repeating precautions that



Position I.

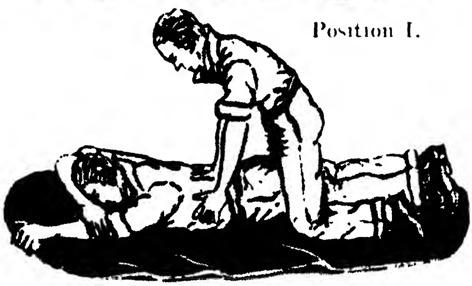


Fig 2.—The two positions in Schafer's method of artificial respiration
(Courtesy Messrs Afr Expl & Ind. Ltd)

have already been suggested or explained. Some of them may seem absurdly obvious, but must not be overlooked.

1. When buying fumigants ask for any commercial pamphlets or booklets that may be available concerning the particular fumigant, and *study* these.

2. Store fumigating materials in any airy, well ventilated, dry, and safe place, preferably under lock and key. Remember tins may rust through, and bottles may crack with temperature changes or vibration. Half-ounce lumps of sodium cyanide resemble confectionery and smell somewhat like almond paste, therefore keep them away from children and natives.

3. Before commencing a fumigation make sure you understand properly exactly what you are going to do.

4. Make sure that any assistants you have are also acquainted with the whole plan.

5. Plan against accidents and how you will meet them should they occur.

6. When sealing a building plan how you will ventilate it after fumigation, and make the necessary preparations.

7. When handling acid keep handy a pail of water in which some washing soda has been dissolved, and use it immediately for washing any places, on your person or elsewhere, where acid spills.

8. Avoid acid splash both while mixing and while lowering the cyanide into liquid.

9. When using the pot method always mix the chemicals in the order recommended.

10. If paper bags are to be used for holding cyanide, fill them just before they are needed. The chemical is hygroscopic and may become wet, causing the bag to break as you are lowering it into the acid.

11. Use sacks or hessian to hold paper bags containing large amounts of cyanide.

12. At all times avoid breathing HCN gas.

13. Be careful generally; don't take chances or rely on luck. Keep cool mentally and physically; act precisely.

14. Don't spill liquid cyanide on the person, clothes, or furniture.

15. Check up rubber connections, if any, on liquid cyanide apparatus.

16. Protect floors by placing generators in baths or deep trays, or by using paper on which to scatter dry generating chemicals.

17. If in doubt whether to wear a gas mask, wear one if you know it is in good condition and if you know how to put it on properly.

18. Make sure the building is empty of humans and domestic animals before fumigation.

19. In small fumigations keep everyone in sight; in larger jobs, have your crew work in pairs, each operator never to leave his colleague until they are both outside.

20. Avoid long exposure to gas even if you are wearing a gas mask, and especially if your skin is damp. Poison can be absorbed through the skin.

21. Wash the hands after using any form of cyanide.

22. Destroy or mutilate used containers, and wash generating vessels after use.

23. Lock the entrance to a building that is being fumigated.

24. Place a warning sign at the entrance to a building that is being fumigated or subsequently ventilated, *e.g.*, "POISON GAS—DANGER." Prevent the entry of natives and domestic animals into such a building.

25. If one or more rooms in a house or other building are being fumigated the whole building must be regarded as dangerous, and must be properly aired—flats and semi-detached houses included—unless special precautionary arrangements can be made.

26. Don't re-occupy a fumigated room until it has been properly aired. Remember, bedding, upholstery, curtains, and even porous walls absorb gas during fumigation and give it off slowly afterwards.

27. Familiarise yourself with the first aid methods set out in an earlier section, and *underline* those portions which you think you might need to refer to in a hurry.

28. Read the precautions after fumigation as well as before. This will impress on your mind next time what you may have omitted this time.

29. Use your common sense. If it does not help you to observe the above precautions, don't fumigate. If it makes you disagree with them, write to the Department about it.

Deeds, not weeds, should be your goal.
Cleanliness aids insect control.

Rhodesia Weather Bureau.

FEBRUARY, 1939.

Pressure.—The mean barometric pressure of the month was persistently low and averaged about 2 mb. below normal. The lowest pressure recorded in Bulawayo in February, since 1903, was 866.4 mbs. (corrected) in 1913 and at Salisbury 852.6 mbs. in 1899, when 18.79 inches of rain fell.

Temperatures.—Mean maximum temperatures were generally well below normal and mean minimum temperatures were very high, leaving the average at or slightly above normal at the majority of stations.

Rainfall.—Mean rainfall over the country was greatly in excess of normal, approximately 11.1 inches. This figure was exceeded in February, 1899, with 12.13 inches, and in February, 1907, with 11.33 inches, but has not been approached in recent years. In comparison with normals, the rainfall was particularly heavy in the south, where the mean approaches three times the average.

The approximate mean rainfall to the end of February is 32.8 inches, about ten inches above the average. This figure has been exceeded in the same period on three occasions in the last 40 years, 1914-15 with 33.1 inches, 1917-18 with 38.6 inches and 1924-25 with 36.5 inches.

The weather generally was overcast and dull and a large proportion of the precipitation occurred as rain due to a trough extending through the country from Beira to the Falls.

Station.	Inches.	Normal.	No. of Days.
Beitbridge	5.41	1.52	13
Bindura	14.75	7.12	21
Bulawayo	13.52	3.90	24
Chipinga	17.14	7.20	22
Enkeldoorn	9.77	5.51	22

Station.	Inches.	Normal.	No. of Days.
Fort Victoria...	8.59	4.70	22
Gwaai Siding...	5.35	3.73	22
Gwanda	12.06	3.44	25
Gwelo...	12.06	5.19	27
Hartley	9.21	6.71	22
Inyanga	13.57	7.52	24
Marandellas	9.08	6.91	21
Miami	12.64	6.23	22
Mount Darwin	11.65	6.74	17
Mount Nuza...	16.08	9.64	25
Mtoko	9.21	5.87	23
New Year's Gift...	15.30	3.85	21
Nuanetsi	11.11	2.35	20
Plumtree	8.19	4.43	20
Que Que	14.42	6.23	24
Rusapi	7.74	5.32	19
Salisbury	16.81	6.43	25
Shabani	8.48	3.69	24
Sinoia...	12.85	6.62	23
Sipolilo	11.56	6.66	24
Stapleford	18.31	14.16	26
Umtali	14.37	5.90	22
Victoria Falls	10.17	5.51	24
Wankie	13.67	4.70	24
Abercorn	8.40	—	18
Balovale	3.58	—	11
Broken Hill	9.32	—	23
Fort Jameson	4.61	—	15
Isoka	5.99	—	8
Kalomo	10.81	—	20
Kapiri Mposhi	11.49	—	24
Kasama	7.50	—	19
Kasempa	8.12	—	15
Livingstone	11.29	—	25
Lusaka...	13.80	—	24

Station.	Inches.	Normal.	No. of Days.
Mankoya	8.01	—	17
Mazubaka	7.71	—	20
Mkushi	10.01	—	21
Mongu	9.81	—	19
Mpika	5.13	—	16
Mporokoso	9.10	—	16
Mufulira	10.08	—	20
Mwinilunga	8.41	—	20
Namwala	5.78	—	22
Ndola	13.24	—	24
Petauke	14.15	—	21
Senanga	6.19	—	15
Sesheke	6.43	—	15
Shiwa Ngandu	7.53	—	18
Solwezi...	7.15	—	17

FEBRUARY, 1939

Station	Altitude (Feet)	Temperature in Stevenson Screen at 4 feet °F: 8-30 a.m. Dry Bulb.	Wet Bulb.	Dew Point	Vapour Press. Deficit	Maximum	Minimum	Max + Mim. ÷ 2	Absolute: Maximum	Date	Minimum	Date	Number of Days: Max. > 85°	Max. < 70°	Min > 65°	Min. < 40°	Mean of 24 hours	Pressure Millibars: 8-30 a.m. Station Level	8-30 a.m. 1200 gdm.	Mean of 24 hours	Cloud Tenths	Sunshine Hours
Beitbridge...	1,486	76.2	71.1	68	6.9	87.5	71.2	79.3	95	7	67	17	19	...	28	...	77.4	959.7	878.6	959.8	7.2	...
Bindura...	3,700	69.0	66.6	65	2.9	78.9	64.6	71.7	82	9	62	3	..	...	7	...	69.7	...	...	...	6.9	...
Bulawayo	4,393	66.8	64.8	64	2.3	76.7	62.7	69.7	82	10	60	8	...	1	...	...	69 7	865.8	877.2	864.6	9.0	3.8
Chipinga	3,685	70.7	67.5	66	4 1	77.5	64.3	70.9	82	5	61	11	...	3	3	...	69.7	888 8	878.3	...	7.3	...
Enkeldoorn	4,808	67.5	64.2	63	3.9	76.9	61.6	69.2	84	9	57	28	...	1	...	...	67.2	854.1	877.7	...	7.0	...
Fort Victoria... ...	3,571	70.3	66.7	65	4.5	80.3	65.2	72.8	87	9	61	28	2	1	16	...	71.1	891.9	877.9	892.7	5.5	...
Gwaai Siding... ...	3,278	70.7	68.1	67	3.3	83.5	66.9	75.2	9C	12	64	27	8	..	25	...	...	900.3	877.1	...	7.8	...
Gwanda...	3,233	70.7	67.7	66	3.8	79.8	66.1	72.9	86	11	61	22	2	2	18	...	70 5	902.1	877.6	...	8.8	...
Gwelo	4,629	67.2	64.6	63	3.3	76.6	62.4	69.5	82	9	58	28	...	1	...	...	...	858.9	877.4	...	7.8	...
Hartley...	3,879	68.9	66.0	64	3.6	78.4	63.3	70.8	83	9	59	28	..	...	3	..	69.1	882.2	877.7	...	6.2	...
Inyanga...	5,503	65.9	63.4	62	2.8	71.8	59.2	65.5	77	11	54	6	...	7	...	...	64.1	...	...	...	7.8	...
Marandellas	5,453	64.7	62.1	51	2.8	73.3	59.6	66.5	82	3	57	28	...	4	...	...	64.6	...	...	...	6.9	...
Miami	4,090	66 6	64.9	64	1.9	77.3	62.7	70.0	82	9	59	26	..	...	1	...	67.9	875.7	877.7	875.3	8.2	...
Mt. Darwin	3,179	70.5	67.7	66	3.5	80.1	66.3	73.2	84	2	63	3	...	...	20	...	71.7	...	...	...	8.6	...
Mount Nuza	6,668	59.4	58.3	58	1.1	65.4	55 2	60.3	69	20	52	11	...	28	...	...	59.0	798.9	878.1	...	8.5	...
Mtoko	4,136	68.6	65.7	64	2.6	74.4	63.4	68.9	78	9	61	6	...	2	1	...	68.0	874.7	878.3	874.0	7.5	..
New Year's Gift...	2,690	73.3	69.5	68	5.0	83.0	65.8	74.4	89	11	62	11	9	...	17	...	...	...	...	...	...	4.4
Nuanetsi	1,547	75.4	72.1	70	4.7	87.0	70.4	78.7	96	2	65	22	18	...	27	...	...	957.7	878.5	...	8.3	...

FEBRUARY, 1939 (continued)

Station	Altitude (Feet)	Temperature in Stevenson Screen at 4 feet °F: 8-30 a.m. Dry Bulb.	8-30 a.m. Wet Bulb.	8-30 a.m. Dew Point	8-30 a.m. Vapour Press. Deficit	Maximum	Minimum	Max. + Mim. ÷ 2	Absolute Maximum	Date	Absolute Minimum	Date	Number of Days Max. > 85°	Max. < 70°	Min. > 65°	Min. < 40°	Mean of 24 hours	Pressure Millibars 8-30 a.m. Station Level	8-30 a.m. 1200 gdm.	Mean of 24 hours	Cloud Tenths	Sunshine Hours
Plumtree	4,549	67.6	64.8	63	3.2	77.1	63 1	70.1	82	2	60	22	...	1	...	...	70.1	...	...	...	6.9	...
Que Que	3,999	68.3	65.8	64	3.0	79.0	64.0	71.5	86	12	60	28	1	...	3	...	68.9	878.4	877.6	878.3	7.8	...
Rusape	4,648	68.0	64.4	62	4.3	77.1	62.0	69.6	82	14	58	2	...	2	..	...	58 0	...	.	...	7.6	...
Salisbury	4,831	66.4	63.5	62	5 0	75.9	60.5	68.2	81	26	58	4	..	1	...	..	66.7	853.4	878.1	852.0	8.4	4.6
Shabani	3,131	71.6	68.1	66	4.5	81.5	66.9	74.2	92	12	64	22	10	...	23	...	72.3	...	...	...	9.0	...
Sinoia	3,795	68.9	66.3	65	3.2	78.9	63 9	71 4	80	9	61	26	...	...	3	...	69 7	..	...	...	7.8	...
Sipolilo	3,875	67.7	65.6	65	2.5	77.9	62.9	70.4	85	1	61	6	.	..	...	...	...	...	...	...	8.5	...
Stapleford	5,304	64.8	62.8	62	2.3	71.7	58.0	64.8	75	10	52	6	..	6	..	...	63.7	...	...	...	7.6	...
Umtali	3,672	70.1	67.2	66	3.6	79.5	64.7	72.1	86	2	62	6	1	...	8	...	69.3	889.0	878.1	889.3	6.9	...
Victoria Falls... ...	3,009	71.5	69.1	68	3.0	84.6	67.0	75.8	92	1	64	26	10	...	24	...	72.7	..	...	...	7.8	...
Wankie...	2,569	73.0	70.6	69	3.2	86.3	68.3	77.3	92	14	63	2	17	..	26	...	78.9	922.6	877.0	...	7.8	...
Abercorn	5,458	65.2	61.3	59	4.3	75.1	58 5	66.8	80	17	55	4	...	2	...	...	...	836.5	879.9	...	4.9	...
Broken Hill	3,911	66.3	64.9	64	1.7	80.0	63.4	71.7	84	23	61	8	...	..	1	...	..	881.7	877.9	...	9.2	...
Chipili	3,900	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Fort Jameson ...	3,815	70 2	66.2	64	4.9	80.9	65 0	72.9	87	22	63	17	1	...	8	...	...	885.5	879.0	...	6.3	...
Kasama...	4,562	67.0	64.0	63	3 5	79.9	61.8	70.9	84	20	60	1	...	...	...	...	...	...	...	...	...	...
Kasempa	4,500	65.0	63.4	63	1.8	79.3	60 9	70.1	83	17	58	9	..	...	...	...	...	...	...	...	...	...
Livingstone	3,051	69.1	68.2	68	1.1	83 5	66.2	74 8	90	1	63	26	8	...	21	...	72 1	907.1	876.5	906.9	8.9	...
Lusaka	4,193	67.1	65.1	64	2.3	77.1	63 2	70.5	82	9	61	4	..	...	1	...	68.2	872.4	877 6	870.9	9.4	...
Mazabuka	3,385	68.8	67.2	67	2.0	79 4	65.1	72.3	84	9	60	2	.	...	13	...	...	...	...	...	...	...
Mongu	3,481	70.7	68 0	67	3.4	83.3	66 0	74.7	91	1	62	13	7	...	20	...	...	893.8	876.8	...	7.1	...
Mpika	4,620	66.5	64.0	63	2 8	79.5	61 6	70 5	83	20	58	24	.	.	..	...	...	861.3	879.5	...	7 8	...
Mwinilunga	4,450	65.4	63.8	63	1 7	79.0	60 5	69.7	83	20	59	var	...	...	.	...	...	...	...	...	...	...
Ndola	4,190	66.1	64 6	64	1.7	78 2	62.5	70 4	85	22	59	16	...	...	...	...	...	873 7	878.7	...	8.7	...

Rainfall in February, 1939, in Hundredths of an Inch. Telegraphic Reports.

Area	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	Total	Normal
1	3	10	78	46	27	37	43	41	28	38	62	5	10	15	95	33	18	65	68	26	5	11	43	64	79	27	82	27	1086	378
2	5	16	..	22	22	17	2	21	22	46	1	...	22	84	15	15	60	35	112	75	59	22	101	35	40	76	217	2	1144	540
3	...	1	5	100	5	13	77	38	112	...	...	49	66	65	193	17	3	1	93	147	55	103	35	6	120	43	296	48	1691	794
4	54	45	11	36	35	6	8	10	20	48	44	...	29	59	7	14	19	12	83	68	110	84	195	29	5	26	261	26	1344	615
5	17	4	21	38	19	12	94	5	32	4	105	10	117	27	44	17	18	149	32	5	34	51	27	70	53	13	45	5	1068	508
6	82	42	76	62	17	1	36	9	135	7	34	34	28	23	66	41	11	75	41	35	117	24	39	5	1	6	21	25	1093	707
7	15	38	35	40	17	7	31	18	38	27	1	44	11	28	54	37	72	24	84	76	99	47	85	15	12	53	42	46	1096	656
8	99	117	126	56	68	5	46	14	157	35	22	202	13	177	39	86	14	31	66	21	45	12	34	3	...	36	47	27	1598	705
9	65	12	54	3	31	10	1	47	181	19	19	286	64	114	4	79	5	28	55	10	67	25	35	6	...	1	54	25	1300	648
10	3	117	10	54	49	..	13	11	2	44	.	187	60	81	46	79	23	21	.	57	105	1	55	5	1	1	10	8	1043	611
Mean	29	26	42	36	25	13	35	22	64	25	38	64	42	51	46	37	26	59	59	36	58	29	55	32	31	26	80	20	1106	558

Southern Rhodesia Veterinary Report.

FEBRUARY, 1939.

DISEASES.

No fresh outbreaks of scheduled diseases.

TUBERCULIN TEST.

Four head were tested upon importation with negative results. A herd of 261 head at Shangani was re-tested and three animals reacted; also 30 head of cattle were tested at Bulawayo, prior to export, and three head reacted.

MALLEIN TEST.

Nil.

IMPORTATIONS.

From the United Kingdom.—Heifers 3.

From the Union of South Africa.—Bulls 25, sheep 898.

From the Bechuanaland Protectorate.—Sheep 29.

EXPORTATIONS.

To Union of South Africa.—Oxen 17, cows 14.

To Northern Rhodesia.—Bulls 23, sheep 50.

To Portuguese East Africa.—Cattle 94.

EXPORTATIONS.—MISCELLANEOUS.

To the United Kingdom.—Chilled beef quarters, 4,460; frozen beef quarters, 183; tongues, 96 lbs.; livers, 395; hearts, 73 lbs.; tails, 77 lbs.; skirts, 108 lbs.

To Northern Rhodesia.—Nil.

To the Belgian Congo.—Beef carcases, 132; mutton carcases, 4; offal, 291 lbs.

To the Union of South Africa.—Corned beef, 79,320 lbs.

To the Bechuanaland Protectorate.—2,232 lbs.

S. A. Myhill,
Chief Veterinary Surgeon.

SOUTHERN RHODESIA

Locust Invasion, 1932-39.

Monthly Report No. 75. February, 1939.

All reports refer to the Red Locust (*Nomadacris septemfasciata*, Serv.).

Winged swarms have been reported in the following districts, namely: Lomagundi, Darwin, Mazoe, Mtoko, Umtali, Bikita, Ndanga, Belingwe, and Gwanda. Practically all these swarms were stated to be egg-laying.

Hoppers have hatched out in the districts of Lomagundi, Darwin, Mrewa, Mtoko, Inyanga, Umtali, Melsetter, Bikita, Charter, Victoria, Ndanga, Chibi and Belingwe.

One instance of parasitisation of adult locusts with *Dipterous* maggots was recorded, and in another instance *Stomatorhina* maggots were observed attacking the eggs.

Hatchings in various localities occurred about the middle of the month, that is about ten days to a fortnight earlier than in 1938. The hatchings are fully as heavy as occurred last year, but there is nothing in the nature of a general outbreak.

The hoppers are being destroyed in all accessible localities.

RUPERT W. JACK,
Chief Entomologist.

NOTICE

The Agricultural Journal of S. Rhodesia

is issued by the Department of Agriculture, and can be obtained upon application to the Editor. The Annual Subscription, which must be paid in advance, is 5/-, and payment may be made by any means other than by stamps.

A 10/- note will cover the subscription for two years.

Persons residing outside Southern and Northern Rhodesia may become subscribers by paying 2/- in addition to the subscription, to cover postage.

If payment is made by a cheque drawn on a bank outside Rhodesia, commission must be added.

All cheques and postal notes must be made payable to the Secretary for Agriculture and Lands.

Date.........................19.....

To the Secretary,
Department of Agriculture and Lands,
Salisbury.

Please enrol me as a subscriber to the "Rhodesia Agricultural Journal" for one year from....................................

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THE RHODESIA

Agricultural Journal

Edited by the Director of Agriculture.

(Assisted by the Staff of the Agricultural Department).

PUBLISHED MONTHLY.

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VOL. XXXVI.] MAY, 1939. [No. 5.

Editorial.

Contributions and correspondence regarding subjects affecting the farming industry of Southern Rhodesia are invited. All communications should be addressed to:—The Editor, Department of Agriculture, Salisbury. Correspondence regarding advertisements should be addressed:—The Art Printing Works, Ltd., Box 431, *Salisbury.*

Continue April Cleanliness in May.—The hints on agricultural cleanliness to be observed in May were given in these columns in our April number, and should be again referred to. Briefly, they cover early uprooting, constant cleaning of sheds, attention to disused seed-beds, low cutting of maize stalks, frequent collection of fallen or infested fruit, and destruction of crucifers that have passed their prime. Early ploughing, apart from other advantages, is desirable for the sake of cleanliness.

If clothes moths played havoc in your wardrobe this season it is because you did not start preventive measures early enough, or you omitted to dispose of those discarded and useless woollens, furs, etc., stored in cupboards and old

trunks. Possibly you omitted both precautions. Prompt action and suitable and early disposal of refuse are important in controlling clothes moths. They are also of fundamental importance in hygienic farming:—"Cleanliness Aids Insect Control."

Varietal Adaptability.—Such problems as varietal adaptability, varietal adaptation, and varietal acclimatisation have been given considerable attention by workers in the field of experimental and scientific agriculture. These terms are frequently used without any regard for the fundamental reasons which condition the response of a variety or strain under a given set of environmental factors. The reader or listener is frequently left with the impression that a plant is something of a mobile or plastic entity that is expected to undergo a process of self-adjustment over a period of years. Once this process of adjustment is completed a hypothetical favourable response is observed and the variety is supposed to be well and properly acclimatised. Through some freak of nature it has become adapted to local conditions.

At the outset, it must be realised that development is a function of heredity and environment. Although the hereditary reaction may vary, the hereditary constituents are stable. All characters have a hereditary or genetic basis and this basis in the form of factors, or genes, is consistent for any particular character. Environmental factors may alter the expression of genetic factors and some of these genetic factors may be more susceptible to influence than others. The hereditary constituents, or factors, are frequently referred to as the gene complex. Characters, on the other hand, are end products of the whole hereditary reaction system, reacting with its environment. Characters are not carried in the chromosomes. Only the hereditary factors or genes are carried in the chromosomes. There is no such thing as a unit character.

Conceptions such as those stated in the first paragraph are not only dangerous but they are, in addition, highly misleading. By those who entertain these views a great deal of time and money may be conscientiously wasted in a vain attempt to induce varietal improvement through mere acclimatisation

or adaptation. In the process frequently referred to as acclimatisation there is no accompanying change in the genetic constitution of the plant, unless it be induced through temperature effects of either extreme heat or cold. No change, however, has yet been induced in any chromosome mechanism which has any adaptive relation to the circumstances inducing it. Instead, hereditary properties always arise in advance of the uses to which they are put.

It is, however, true that plant selection is a powerful means of improving plants with respect to particular characters, providing the variety is not a pure line. If the variety is a pure line, that is, the progeny of a single self-fertilised individual of homogeneous factorial composition, improvement as a result of continued selection is impossible. Continued selection within a pure line can maintain only the purity of the variety and no more. If the variety, when introduced, is not a genetically pure one, then continued selection under local conditions may result in the establishment of a strain more desirable than the original mixture. In such a phenomenon is probably found the real explanation for the common conception erroneously termed "acclimatisation."

The extent to which varietal improvement may be conducted as a result of individual selections from mixed populations is definitely limited. At its best it is only possible to establish or eliminate certain factors or sets of factors which previously existed in the original material. If the number of factors involved are few, the process should require but relatively few generations of selfing, whereas many generations are frequently essential if the number is large. Through the instrument of selection, figuratively speaking, it is possible to shift the expression of certain characters in either one direction or another. In any case, it is possible to capitalise only on the factors already contained in the material under investigation. It may as well be realised now that no amount of selection, should it be carried on for fifty generations, is capable of building up certain characters if the factors necessary for the expression of such are not a part of the genetic constitution of the original selection.—*The Lighter.*

Veld Management.—In this issue there appears an article on Veld Management written by Mr. H. C. Arnold, Manager of the Salisbury Experiment Station. The following notes, written by Mr. G. A. Gill, Botanist of the Grootfontein College of Agriculture for the Union of South Africa Department of Agriculture *Press Service*, form such an admirable introduction to Mr. Arnold's paper that they are reproduced for general information.

"The public conscience has been awakened in regard to the urgent need for adequate methods of veld preservation. Every farmer who has given any thought to the matter, and there is surely not one who has not, agrees in principle that steps need to be taken to prevent the steady deterioration of our natural pastures which appears to be going on everywhere. There are still too many farmers who have not taken any steps to carry their conviction into effect. What are the reasons for this lack of co-ordination between thinking and doing? Is it merely slackness or are there some special snags about the business that make it impossible for the average man to do something tangible?

One of the chief bogeys is undoubtedly a deep-rooted suspicion that veld improvement is closely linked with cheque-book farming. In other words, it is not a proposition that yields financial dividends, and although a dividend in the shape of the gratitude of posterity would not be unwelcome, yet it cannot be used to settle up the everlasting monthly bills so worrying to the present generation. Fortunately for the advocates of improved methods of veld management, practical farmers in every district of South Africa are helping to break down this paralysing idea.

There is no doubt that veld improvement can be made to pay for itself if carried out on sensible practical lines. Admittedly, one still comes across enthusiasts whose ideas of ideal methods of veld improvement lie in the direction of total protection from all grazing for a large number of years. Such ideas are usually based on theoretical considerations which have proved fallacious in practice. One of the most important considerations in sound veld management is the maximum utilisation of the forage potentialities of a pasture during the period of its improvement.

Another excuse offered for not taking active steps towards pasture management is that no experimental work has been done under local conditions and that it is too risky and expensive for a private individual to carry out such work. The answer to this is that although valuable information can always be gained by special research work on local problems, there are certain well-established principles which are of application everywhere. It is a commonsense rule to rest a camp sometimes and to let it seed; to make the best subdivisions of the grazing that are possible in accordance with the available drinking places. Many improvements can be effected without waiting for a lead from detailed experimental work, which, quite rightly, cannot be attempted by an ordinary farmer. In many cases these initial improvements mean only a change in the farming organisation and do not call for capital expenditure.

The year is still young enough for just one other good resolution to be made. What better resolution can there be than a determination to make some attempt, however small, in the way of veld improvement during the year?

Branding Cattle.—The attention of cattle owners and others is drawn to the provisions of Government Notice No. 352 of the 21st May, 1937, which was published in terms of "The Brands Ordinance, 1900," and which indicated the particular parts of an animal on which brands shall be imprinted, which are shown as under:—

"(*b*) In the case of cattle, the first brand shall be imprinted on the near cheek or near side of the neck. The second brand on the off cheek or off side of the neck. The third brand on the near shoulder and below the point of the shoulder. The fourth brand on the off shoulder and below the point of the shoulder. The fifth brand on the near hind thigh below the stifle joint. The sixth brand on the off hind thigh below the stifle joint. In the case of subsequent brands they shall be imprinted on the parts of the beast in the order above immediately above the previous imprint."

The co-operation of all farmers, ranchers, cattle buyers and traders is earnestly sought with a view to complying with the branding regulations as set out above in the confident belief that the value of the hides and skins exported will thus be improved. Brands on the rump may easily decrease the value of hides by 25 per cent. or more, and the careless branding of cattle on the best parts of the hides still costs producers in this Colony a large sum of money annually.

Danger in Second-hand Fruit Boxes.—It has come to the notice of the Department that certain fruit growers in Southern Rhodesia have adopted the practice of packing deciduous fruit in second-hand boxes or trays for marketing. Most of the second-hand containers of this nature obtainable in the Colony have brought deciduous fruit from the Union of South Africa, including large quantities of pears, apples, apricots, and peaches, and also some quinces. All these fruits are liable to bring the larvae of the Apple Codling Moth into the Colony, and despite careful inspection and rigid application of the Plant Import Regulations at the Ports of Entry, a certain number of larvae must escape detection. Many of these, either before or after inspection, leave the fruit and hide in cracks, crevices, and nail-holes in the containers, or in paper wrappings or wood-wool. They can work their way into exceedingly small spaces. In these places they would normally pupate, or if disturbed, crawl elsewhere to pupate.

If such containers or packing materials are taken in quantity to a fruit farm, they may form a nucleus that, provided our climate is suitable, may lead to a field infestation on the farm. This may spread to neighbouring farms and give rise eventually to a Codling Moth infestation throughout the Colony.

Fruit growers are therefore warned of the very serious repercussions that may result in the practice of allowing second-hand containers or packing materials to be brought to their farms. A second-hand box is not necessarily infested. But it is not necessarily clean, and—Cleanliness Aids Insect Control.

Trees and Wild Flowers.

ON THE RHODESIAN FARM.

By Chas. K. Brain, M.A., D.Sc., Director of Agriculture.

PART V.

The Proteas or Sugar Bushes. Fam. *Proteaceae.*—The Proteas are mostly South African, but a few species are found in Tropical Africa. Although over 80 species occur in South Africa, only about one-tenth of this number extend into the Tropics. There are only four or five which can be looked upon as common in Southern Rhodesia. They are shrubs or small trees and are readily recognised by the large head of flowers. They may be distinguished by the leaves. The commonest species, *Protea abyssinica* Willd. (Fig. 35) has leaves usually about 5 or 6 inches long, and about 1 inch wide. In this species the leaves are quite smooth and entirely without a hairy covering. The large silvery white flower-heads appear in October-November. (Fig. 36) *Protea angolensis* Welw. is often found associated with *abyssinica.* It also has smooth leaves, but they are broadly oval and often reach 2½ or 3 inches in breadth, and the flower-heads open in April-May. (Fig. 37) *Protea hirta* Klotzsch. has leaves up to 1 inch in breadth, but they are densely felted with hairs and *P. melliodora* E. & G. is probably only a scrub form or *hirta.* A fifth species was recently discovered near Selukwe by the Conservator of Forests. This has small leaves, only about 3 inches long and less than half an inch wide, which taper downwards into a long stem. This is *Protea petiolaris* W. & E. Two other scrub forms of Proteas have been recorded from the Eastern Border.

The two commonest Proteas, *viz.*, *P. abyssinica* and *P. angolensis*, are most common in the granite sand tree-veld with an altitude of 4,500 to 5,000 feet. They are usually associated with such trees as "Muhatcha," *i.e.*, *Parinarium mobola*, which is one of our finest shade trees; Msasa, Mnondo and Kaffir orange trees.

Achyranthes aspera Linn. Fam. *Amarantaceae*.—This is a common weed throughout the hotter parts of the Old World. It flourishes best in the shade of trees or wherever the undergrowth is thick. It usually grows to a height of 2 to 3 feet and has hairy stems and leaves. The leaves are usually about 2 to 3 inches long, crinkled, and narrowed to each end. They are opposite on the lower parts of the stem, but three or four arise from the same level in a whorl below the flower head. The inflorescence or spike of reddish flowers is at first only a few inches long, but as the seeds are formed from the bottom upwards the stem elongates to as much as 2 feet and the sharp pointed seed cases turn downwards close to the stem (Fig. 38). The plant is not poisonous and the young parts are eaten by cattle. Further north in Africa the natives chew the root and apply it to cuts to stop bleeding. Common January-March.

The Common "Black Jacks." Fam. *Compositae*.—The "Black Jack" is one of the best known weeds in the country because of the long barbed seeds which attach themselves in such numbers to stockings and clothes. The common name "Black Jack" is of South African origin. In Queensland the weed is called "Cobbler's Pegs" and in Canada "Beggar Tick" or "Pitchfork."

Two species are common in this country, *Bidens pilosa* Linn being most prevalent in open lands and *Bidens bipinnata* Linn in the shade of trees. They are readily distinguished by the leaves, as shown in illustrations 39 and 39a. The composite flower heads are dense and inconspicuous, but under some conditions the white ray florets are well developed. Generally, however, the ray florets are either very small and yellow or apparently absent. The young plants are relished by cattle and are said to have a high feeding value. They are comparatively rich in an essential oil which has an objection-

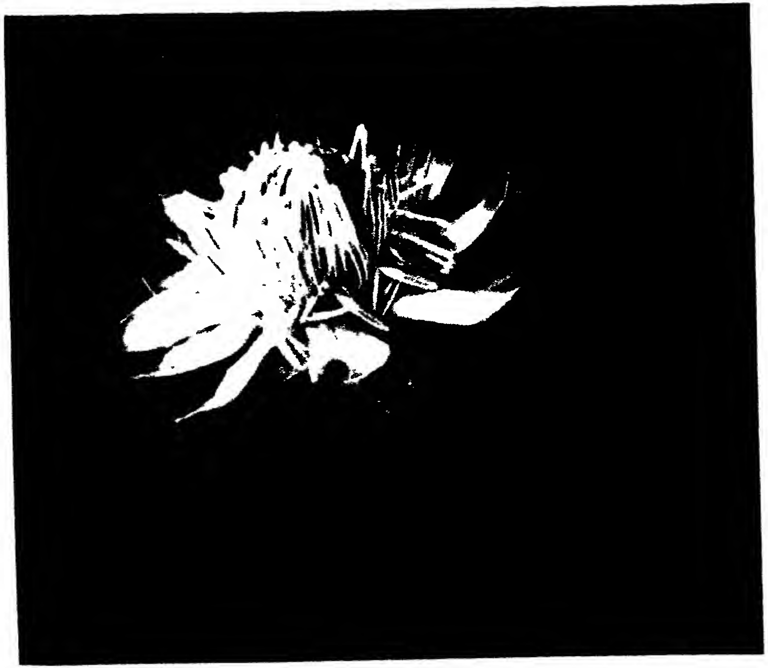

Fig 37 —*Protea angolensis* Welw Salisbury Commonage flowering at the end of April

Fig 38 —*Achyranthes aspera* L. Salisbury. March

Fig. 39 - *Bidens pilosa* L. The common 'Black-Jack'.

Fig. 39a - *Bidens bipinnata* L. The shade-loving 'Black-Jack'.

Fig 40 *Solanum nigrum* L. A common weed with small white flowers

Fig 41 -*Pycnostachys urticifolia* Hook. Salisbury Commonage April

able aroma and there is little doubt that they account for a taint in milk at certain times of the year. They grow most profusely in the rainy season, but continue growing throughout the year wherever conditions are suitable.

Solanum nigrum L. Fam. *Solanaceae.*—This plant, commonly called the Black Nightshade, is a common weed of this country. It grows abundantly in old cattle kraals and other places where the soil is rich. It is an annual, usually between one and two feet in height. The flowers are small and white and the berries, which grow in clusters, are sometimes dark red but usually black when ripe. These ripe berries are often eaten by children and are sometimes collected and made into jam. Cases have been recorded of children being poisoned by eating the berries, and this is not surprising, as it has been definitely proved that the green immature berries are poisonous (Fig. 40).

Pycnostachys urticifolia Hook. Fam. *Labiatae.*—This is a native plant which is often seen in vleis or on river banks and grows to a height of 5 or 6 feet and has numerous stems from the base. The leaves are broad, deeply crenate and pubescent. The flower heads are dense and the sky-blue flowers appear from the bottom first. As the flowers fall the spiny seed head extends until it may reach four or five inches long with a few small flowers at the top (Fig. 41). The flowers last for a long time in water. A smaller species occurs in the wettest parts of vleis or on the banks of streams. This has been determined by Kew as *P. remotifolia* Baker and is easily recognised by the smaller flower-heads and the long, very narrow leaves. The name *Pycnostachys* refers, of course, to the dense spike of the flower and seed head. Both species flower from March to May.

Some Notes on Game Bird Preservation

Prepared by W. E. Poles, Esq., on behalf of the Wild Life Protection Society of Southern Rhodesia.

The impending introduction into the Colony of an exotic game bird, the Chukor partridge, shows the desire of a body of sportsmen to make a real effort to improve the conditions of sport in Southern Rhodesia. Naturally, the minds of those interested in the acclimatisation of this partridge will turn to thoughts of how best to preserve and care for their charges before and after their release.

The balance of nature is preserved until man takes a hand. When he interferes in the constant battle between game and vermin the issue of whether game will increase or perhaps even entirely disappear will depend on whether his actions are beneficial or destructive.

The following notes are intended to assist those who are willing to undertake game preservation in order not only to maintain, but actually to increase the available shooting on their properties.

The means which must be employed are:—

(*a*) Reduction of vermin to a minimum and prevention of poaching.

(*b*) The rendering of the preserve as attractive to game as possible.

(*c*) Assistance to game to obtain food during the lean months of August, September and October, by winter feeding.

(*d*) Shooting in the open season in such a manner as to leave sufficient breeding stock for the following year.

(*e*) Additions to the natural stock by rearing game birds under domestic conditions and releasing them on the shoot.

Let us consider these points in the order in which they are set down and discuss how they can best be put into practice.

(*a*) **Vermin Control.**—In this country, so far, vermin have had little to fear from man; their numbers seeming only to be restrained by the limits of their food supply. It, therefore, follows that if this supply is augmented by artificially reared birds it is to be expected, unless preventative steps are taken, that there will in time be an increase of vermin in direct ratio to the extra number of birds artificially reared.

Although at present vermin are in great numbers, they are fortunately more or less innocent and unsuspicious of the various wiles by which we may set about their undoing. Wild animals learn surprisingly quickly by experience and care must be taken that there is no bungling in our methods of destroying them, or more will be educated than eliminated.

Before we discuss the various methods to be adopted for vermin extermination it will not be out of place to give a few words of encouragement. One may well ask, "What is the use of spending time and money on an attempt to exterminate vermin on a preserve which may be surrounded by wild, unoccupied country or by other farms where vermin is not kept down?" The answer is, "A great deal of use."

Vermin, both furred and feathered, are surprisingly local; particularly the raptorial birds (except during the mating season and at the time when the young are turned out to shift for themselves). When the adults, or during the breeding season when the parents and their young are accounted for, a considerable time will usually elapse before their beat is again tenanted by others of their species. Once a preserve has been pretty well cleared of vermin it should not be difficult to strictly control any further natural increase, and precautions taken on the boundary will deal with those which are likely to come in from that direction.

Probably the most effective method of dealing with all sorts of vermin is by the use of strychnine, and if reasonable precautions are taken the use of poison need not represent so great a danger to human life and domestic animals, as might at first be imagined. In England, Scotland and Wales,

strychnine is almost unobtainable on account of the extreme strictness of the poison laws, but in Ireland, where there are vast tracts of wild and almost unpopulated country, poison is used extensively and with great success. In the majority of cases poison is used far too lavishly—a very little will do the trick—and it is quite unnecessary, and in fact, altogether undesirable, to use large baits.

It is not the intention or the function of the Wild Life Protection Society to advocate the use of poison—a practice which, if avoidable, is held in abhorrence by the Society and by all sportsmen, but it must be recognised that even a magnificent lion which has taken to habitually raiding cattle kraals, or a mongoose that nightly creeps into our fowl runs can sometimes only be disposed of by this cruel method. This being so, it is as well that a few hints should be given as to the laying of baits.

Against the smaller vermin the common ring dove will make a suitable bait, an incision being made in the breast for the insertion of the poison; an egg also may be used, a small hole being made in the "blunt" end and a little strychnine injected into the air sac, the hole in the egg being sealed with hot candle wax.

Baits should not be scattered indiscriminately but should be placed judiciously in runs where the spoor of the small carnivora is seen. They should be visited early every morning and removed if not eaten.

Strychnine should be obtained in its alkaloid form, which is the most readily soluble and is said to be almost tasteless. It can be purchased in one ounce bottles from most chemists. The law provides that the purchaser must sign the poison register.

Gins, or iron-toothed traps, only a little less cruel than poison, may be set near the homestead, where domestic animals even during the night might pick up poison baits. For small mamals the traps should be set "ticklish," and the plate should be at ground level and lightly sprinkled with the surrounding grass or débris. The bait should be so placed that the marauder must pass over the trap in order to secure

it. Such traps should have 4 inch jaws and should be so placed and enclosed that they will not be a menace to domestic animals or stock of any description.

It may be necessary to dispose of a hawk or other predatory birds that elude the shot gun, and in such a case the pole trap may be found effective, taking advantage of the hawk's predilection for perching on poles and stumps from which he makes the survey of his beat. On such a pole or stump a gin with semi-circular jaws may be set, attached to a wire loop which permits the trap and victim to slide to the ground. This trap should only be set within sight of the hometsead, compound, or occupied huts, so that the trapped bird may be despatched without long suffering. A gin may be set in a small tunnel trap, just a little built-in tunnel three feet in length such as small mammalia love to enter at night. The bait should be placed beyond the traps, from the line of approach, towards the breeding or rearing pens.

Humanity and pity must guide and only real necessity compel us in the use of poison and traps.

The tunnel trap, on account of the narrow width of its approach, is a particularly safe trap to use where small children or household pets are likely to go. These traps should be set as "ticklish" as possible; they are almost the only sort of trap which will take a snake. A word of warning:—Keep a look out that termites do not work over the trap within the tunnel, so binding the plate and jaws that it is impossible for the trap to be sprung.

If a proficient native trapper can be found who is considered sufficiently trustworthy to be employed as a gamekeeper, he may set snares and deadfalls which will be most effective. No doubt he will snare some of the game on the estate, but the old saw is very true: "a good poacher usually makes an excellent keeper." In any case, he will be unlikely to countenance any nefarious competition on his particular beat, and he can be expected to put a stop to other natives

poaching. His presence is bound to be well advertised and this will tend to act as a deterrent to any European who may be tempted to trespass in pursuit of game.

Before leaving the subject, if traps are set: DO MAKE IT A HABIT TO REGULARLY VISIT ALL TRAPS. Those for hawks at evening and the others in the morning. In all humanity it is the least one can do to relieve unnecessary suffering and put an end to the miseries of the trapped.

It is not a bad plan to post warning notices on roads leading to the preserve. Such notices should be conspicuous and politely worded. Some people will disregard a harshly or offensive worded warning when they will respect one which is courteously framed.

Very good warning notices may be obtained, free of charge, from Messrs. Imperial Chemical Industries, Ltd., Millbank, London, S.W.1. They are worded as follows:—

> "Game is preserved here. Please respect in every way that which is the property of others. You are particularly requested to keep to the pathways."

Before passing on, let it be observed that there is no better habit than to constantly carry a shot gun during one's ordinary lawful occasions about the estate. Everyone realises, only too well, that a hawk always flies within range when one is without a gun and is rarely to be met with on those occasions when one goes out armed in search of him. In the course of a season many opportunities present themselves, to the man who habitually carried his gun, for destroying vermin which would otherwise go free.

The following is a good method of getting upon terms with a hawk sitting in a tree, and it is known as "Circling." If the hawk has not previously been subject to much persecution the method is usually deadly.

Approach obliquely towards the bird from the general direction in which it is facing and gradually circle in towards it, at the same time keeping in full view and with the head and eyes cast down, so as to appear ignorant of the hawk's existence and leading the bird to believe that it is intended to pass by. The hawk will never even for an instant take its eyes off the slowly walking human, nor will it move its feet. It can turn its head through rather more than a semi-circle, after which it must reverse its head to follow further. This means that for a fraction of a second it must lose sight of the object of its interest and suspicion, and rather than do this it will fly off.

It is therefore necessary not to complete more than a semi-circle before coming within range. As one moves slowly round one edges inwards, occasionally giving a stealthy glance out of the corner of the eye, until one is satisfied that the bird is within effective range (40 yards). The gun should be held unobtrusively but ready for instant action.

It should be understood that falcons and goshawks are unlikely to fall victims to traps or poison, both species preferring to kill their own food. The gun therefore is the best method of dealing with these.

Most of the eagles, buzzards, kites and crows are easily trapped or poisoned.

Secretary birds (very much on the protected list and I am advising no one to interfere with them) are most destructive to game. Nothing seems to come amiss to their insatiable appetites, small mammals, sitting birds and probably, though I have no direct evidence, eggs. They are largely insectiverous, as indeed are most of our raptorial birds in due season, but that their diet consists principally of snakes is entirely mythical, though they undoubtedly eat any sort of reptile they may come across. A pair of Secretary birds will methodically cover every inch of their ground, beating it out like a couple of English squires of the time of the early eighties. They seem only to need a top hat apiece and bottle-green coats to make the illusion complete.

I do not advocate the indiscriminate slaughter of everything which may be tagged as "Vermin." Let it be the rule to get rid of those species of birds and beasts which are in too great numbers and definitely harmful. The Bateleur eagle, kestrels and the harriers are certainly beneficial. The South African peregrin and the Lanner falcons are noble birds, and though it is admitted that they do take game birds, they hunt like sportsmen and never take a victim, except "on the wing."

Personally, I love to see these aristocratic birds and enjoy their exhibition of absolute mastery of the air. I would hate to kill one. These species are distinctly *rara aves* in my district and consequently the harm they do to game is negligible.

On the other hand, death every time to the goshawks. They will sit all day in a tree above a covey of partridges which, sooner or later, must leave their cover to feed. Then with a lightening, lurching swoop, down comes the "gos" and there is one less partridge on the shoot. A single goshawk will often account for a whole covey in the course of an afternoon.

The Lesser banded goshawk, one of the smallest of the true hawks, is very deadly to immature birds, but is so fierce and bold for its size that there is little doubt, if sharp set, it would also take adult game birds.

(*b*) **Making a Preserve Attractive.**—Game naturally appreciate security, and much has been done to provide this when vermin has been brought under control. This necessary state of affairs is, however, but a step in the right direction. Game also need peace, particularly in the breeding season, and steps must be taken to ensure that they have it.

No game preserve is complete unless a part of it, however small, is set aside as a sanctuary, and this should be chosen with care. First of all an area should be selected which is attractive to game, and the best indication that this is so will be the fact that it naturally holds a good stock of birds. It

should be in such a position that it is unlikely to be poached and sufficiently close to the homestead to enable it to be kept under careful supervision.

A sanctuary must be kept sacred and as quiet as possible. Not only must birds never be walked up or shot, but no shot must ever be fired within its limits and vermin control should be conducted by traps and poison.

Game soon learn of their immunity from danger in such a place and will resort to it for food, shelter and security. Many pairs will breed within it. Game which have taken up residence in the sanctuary will soon become much less wary and suspicious of man, and this will make it easier to observe their habits.

A sanctuary should be kept as quiet as possible. Little harm will be done by cattle grazing over it, providing they are never herded. But in the breeding season driven herds trample out nests and kill very young chicks. At all times massed movements of herds are very disturbing to game, and, in fact, are intolerable to them. Care should be taken to see that the sanctuary is not over-grazed, as valuable food is thus lost to the birds and their cover is unduly depleted.

The grass and herbage in the sanctuary should never be burnt and, if necessary, should be protected by fireguards. The many evils attending veld fires are now generally recognised, but from the point of view of the game preserver, veld fires do immense damage which is not fully appreciated. It is a well known fact that birds need protective cover in which they can move about and feed unseen. If this is denied them they at once become more vulnerable to attack by vermin—particularly from the air. Again, veld fires occur at a period when the natural food supply is at its lowest ebb, and if the little that remains at this time is destroyed by fire, then the existence of game becomes indeed precarious.

Many of our natural grasses are very rich both in the quantity and feed value of their seeds, but these fall comparatively early in the year. They are not lost, however, but remain present in quantity on the ground, beneath the rough

undergrowth of dry grass, and thus are available as food for a very considerable time. Fire, naturally, destroys most of these seeds.

Game birds require a large quantity of green food throughout the year, but when grain (seeds) and other sources of food become scarce they are obliged to fall back on larger quantities of green food to take its place.

In the dry season the only source of supply of green stuff is bulbs and the moist crowns and runners of various grasses which lie dormant below the surface of the ground. The birds scratch these out in quantities, but even under the best conditions this involves a considerable amount of effort, particularly to a bird whose stamina must be already weakened by an inadequate supply of food. If the protective mulch of old herbage is burnt off the ground, the sun and wind dries the surface even harder than ever and renders green food increasingly difficult to obtain.

Where the natural water supply on a shoot is insufficient drinking water must be supplied to the birds. An excellent drinking trough can easily be made by cutting an old motor car tyre right down the centre of the tread. This will supply two troughs. A trough can be placed in the vicinity of pumps and windmills; others should be placed at suitable spots, such as near road sides and farm tracks where they can be regularly visited and kept filled.

Kaffir dogs, hunting about the estate, harass the birds and account for numbers of nests of eggs and young. They break up the broods during the first few weeks of life and many then become lost and die. A Kaffir dog, as a disease carrier, has few equals, and is a constant menace to one's own dogs. Do not allow them near the preserve.

Various berry and fruit bearing trees and shrubs may be planted within the sanctuary, and those which find most favour can later be planted on other parts of the estate. The following is a list of shrubs which are all indigenous to the country and might be tried with advantage.

Fruit and Berry-bearing Trees and Shrubs Indigenous to the Colony.

SHRUBS.

Botanical Name.	Common Name.	Native Name.	Description of Fruit.
Carissa edulis ...	...	Umlugulu Muzambara Amatungula	A dark red berry containing one seed
Vangueria...	Wild medlar. ...	Mutubvu Umbizo Muzwiru	A yellowish fruit containing several seeds.
Lycium persicum	Red kaffir berry ..	..	A red berry containing two seeds.
Flacourtia hirtiuscula	..	Umquedio Mununguru	A reddish-black berry containing several seeds.
Grewia cana ... ... (several species).	Donkey berry	Muburu Umbusu Ehlampunzi	Small dark brown berries containing several seeds.
Rhus lancea .	Bastard Willow	Ugcane	A yellow waxy berry containing one seed.

NOTE.—There are several varieties of "Rhus" with coral-red berries.

Botanical Name.	Common Name.	Native Name.	Description of Fruit.
*Cephalanthus natalensis	White Mulberry	.	As its common name implies
*Dovyalis macrocalyx	Wild Cranberry	Iqokolo	A red berry containing several seeds

TREES.

Botanical Name.	Common Name.	Native Name.	Description of Fruit.
Zizphyus mucronata	Wag-'n-bietjie	Muchecheni Umpafa	Red berries with two seeds.
Vitex hildebrandtii	...	Mutsubvu Mukubwa Umtjonkwela	A black berry with a single stone containing one seed.
Eugenia ... . (several species)	Water-boom ...	Mukute	A cluster of purple berries each with a single seed.
Heeria insignis ...	.	Mbedu Bukati Safihle	Small black berries each containing a single seed.

NOTE.—Two shrubs marked thus (*) are found in the Mount Selinda locality.

I have referred to the book "Some Trees, Shrubs and Lianes of Southern Rhodesia," by Miss E. C. Steedman, and the Forestry Division have added some native names.

(*c*) **Assisting Game by Winter Feeding.**—Our last three winter months, namely, August, September and October, are

a very trying period for all animal life. Green food is very scarce, there is very little grain and there are few insects, so that game birds find it difficult to obtain sufficient food.

It has already been pointed out that in nature, wild life cannot increase beyond its supply of food, and where there is a long famine period each year, nature must make some sort of provision for it. This may well account for the fact that most of our game birds lay very small clutches of eggs. If, therefore, it is desired to materially increase the head of game in a particular area, steps require to be taken to augment the food supply during these months.

The danger of artificial feeding lies in the fact that other birds and animals are attracted to the feed intended for the game, and vermin also will follow. It can, therefore, be appreciated that winter feeding can only be resorted to after vermin has been reduced as far as possible.

We know that during these winter months the game birds are in constant search for grass roots and bulbs. The native snarer takes advantage of this and will hoe out shallow furrows on the edge of the bush, where the birds come out to feed. In these he sets his snares. The birds take advantage of the broken ground, commence digging into the exposed grass roots, and the snares take a heavy toll.

We can learn a lesson from this; the birds have a hard time in procuring their food and are quick to take advantage of broken ground which lends itself to lighter work.

A small, single furrow plough can be used with great advantage to break up ground and assist birds to get at their natural food supply. It is not necessary to do very much ploughing and little work need be done; possibly a little every other day and as the furrow is turned back a little mixed grain may be scattered in it. The furrows should be ploughed a few yards inside the bush, along the edge of vleis, and if the contours are followed as nearly as possible, these single furrows will be beneficial as a check to soil erosion. Grain should be used sparingly and never introduced more than once into the same furrow. The birds will soon learn to associate the freshly turned soil with food, and vermin will

not have time to locate the feeding places which are so frequently changed, as would be the case if feeding were regularly carried out in the same spot.

The practice of planting patches of seed crops, as a source of winter food for birds, is not to be recommended. Doves and other small birds would take the most of it. Rats and other vermin congregate in its neighbourhood and the crop thus becomes a menace instead of being beneficial.

(*d*) **Careful Shooting.**—Our shooting season, for birds, commences on the 1st of May, but the prevalence of late or second broods at this date makes it very inadvisable, in most districts, to start serious shooting so early. The careful and observant sportsman will know fairly accurately where there are well grown coveys, strong on the wing, and where there are still young broods. He can proceed accordingly.

Is there anything more disappointing or more likely to engender self reproach than when on going up to a point early in the season a brace of fully grown birds rise separately, each paying the penalty, and when on working forward a scattered brood of squeakers rises and flutters off? The parent birds are usually the first to rise, leaving their family, which may be too frightened to follow at once. If these old birds are shot the brood is doomed to death by starvation, exposure and the attack of vermin against which they have not yet mastered the art of protecting themselves.

So much for the opening period of the season. Later on, during the middle of the season, the idea should be to shoot moderately and stop, even if there is a considerable period of the season still to run, if it is believed that the stock is becoming too depleted. Always stop shooting in good time in the evening so as to allow scattered coveys to re-unite and jug together in their favourite place. Shooting carried out until it is so dark that gun flash becomes visable is not sportsmanship and can only result in much harm. Coveys should not be chased about; once a covey of birds has yielded sport it should be left alone, at least for the time being, and fresh birds sought. Not more than a brace of birds should be taken out of a covey at one time.

(e) **Augmenting the Natural Stock of Partridges.**—It is not intended to dogmatise on the subject of game rearing which, after all, is only entering upon its experimental stage in this country, but there are several points in connection with the subject which may prove helpful.

First of all, breeding and rearing pens or coops should not be placed close to poultry or on ground where poultry has been kept, otherwise there will be great risk of the birds contracting disease, particularly internal parasites.

Pens or coops should be placed on a gentle slope with a sheltered aspect and the breeding pen should include a piece of natural veld within the wire. Chukor delight in sitting on fallen logs, and a small pile should be provided at one end of the pen.

It is suggested that the normal ration for adult birds should consist of a mixture of mature grain, consisting of wheat tailings, buckwheat, nyouti, rapoko, mafundi and a little crushed maize with a small amount of insect food, or its substitute, and plenty of freshly chopped greens. It should be noted that at the mating season, directly prior to and during the egg laying period, the birds require more insect food than at other times. A dusting place should be provided in the pen, consisting of wood ash, to which a little insect powder may be added. A supply of quartz grit, crushed oyster shell and charcoal should always be available, and the same—very finely crushed—should be placed before chicks as soon as they are hatched. Drinking water must be clean and renewed daily; it should be tinted with permanganate of potash to a pale claret colour and kept in a shady position.

Chukor partridges, being of wild stock, require to be left in peace as much as possible. They should not be continually fussed, and interested and admiring friends should be kept away from the pen. When the birds start breeding the hen will probably try to hide her nest and she should be allowed to think that she has succeeded and not be worried by people looking into it. When the full clutch has been laid all the eggs should be taken up and put under a small Kaffir hen or into the incubator.

It must be realised that game chicks must not be treated like poultry. For one thing, they require much more space and will not stand overcrowding. They require rather different feeding, and care must be taken to see that they are not overfed.

It is a very general fallacy which, incidentally, has only quite recently been disproved, that the staple diet of partridges mainly consists of insects. It is not so, but chiefly comprises grain and green stuff. The wild partridge, for the first ten days of life, lives almost entirely on insects, then the food changes to part insects and part immature seeds, and again, at about the nineteenth day, to mature seeds.

Chopped suet with skim milk forms a good substitute for insect food and is safer to use than to experiment with insects which may not be altogether suitable to the birds' digestions. After ten days this part of the ration must commence to be cut down and thereafter be given sparingly. Never give birds more than they can eat at a single meal; partridges should be given very little food at a time, but be fed frequently. Feed should not be mixed into mashes sufficient for many meals. This will result in the food becoming sour, which in turn will be likely to induce scouring and other digestive troubles.

When eggs are hatched in incubators and the chicks are reared in brooders it is advisable not to let the chicks out on to grass until they are thoroughly strong and fully weaned from the foster-mother. If this precaution is not taken deaths from chills and pneumonia may be expected.

When artificially reared birds are ready for release, a holding pen, which need not be very large, should be constructed at the place where it is intended to put the birds down. They should remain in this pen for about a fortnight; half the birds can then be liberated and a few days later the door can be left open and the remainder allowed to move out. The first lot of birds liberated may be expected to hang about in the vicinity until then. Feeding, outside the pen, should be carried out from the time when the first birds are liberated until some days after all have been let free. If this is done

it will tend to keep the first lot of birds near by and the few days feeding, after release, will be of great benefit to the birds until they have become accustomed to foraging for themselves. Once a wild stock of partridges has been established on a shoot, birds released will quickly join up with them.

In the case of partridges hatched out under Kaffir hens, the coops—hen and chicks—when the latter are about a month old, should be moved to a suitable spot on the edge of the bush, where it is decided to release them. Each coop should be surrounded with wire netting through which the chicks can pass but which will prevent the larger kinds of vermin from doing so. The netting will be some protection against a roving cat or jackal, but not a complete safeguard against anything. Vermin must be under control before the coops are removed from the rearing field to the shoot.

As the chicks grow older they will spend more time in the surrounding bush, until eventually they will no longer return to the coop to be brooded but will jug on their own, in a covey. When this happens the coop and Kaffir hen may be removed.

The hand-rearing of partridges is an expert job and not to be lightly undertaken. The history of game breeding shows that the way of the pioneer is often difficult and disappointing. Fortunately, it also shows that those who have enthusiasm and perseverence, even in the face of repeated disappointments and seemingly insuperable difficulties and who keep an open mind and are willing to throw up old theories and adapt themselves to changed conditions generally succeed in the end.

It is strongly recommended that all those concerned with partridge rearing and game preservation should obtain the following advisory leaflets which are published by Messrs. Imperial Chemical Industries, Ltd., Millbank, London, S.W.1. The pamphlets are issued free of charge and are wonderfully interesting and informative. Although they have been compiled as the result of investigations in connection with the various European species of partridge under conditions appertaining to the British Isles, it is at once

obvious that much of the advice and most of the facts can be applied to Chukor partridges and also to our indigenous francolins. It can also easily be seen that much of the food which forms the ordinary diet of British partridges has its substitutes available in this country.

IMPERIAL CHEMICAL INDUSTRIES' ADVISORY LEAFLETS.

Leaflet No. 1.—The treatment and release of imported Hungarian partridges.

Leaflet No. 2.—Partridges coverts, sanctuaries and nesting sites.

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Ducks on the Farm

By H. G. Wheeldon, Poultry Officer.

The production of ducklings for table use can be regarded as the most profitable in the poultry business next to the raising of pullets for egg production.

Although the raising of ducks in Rhodesia has received some attention and is a profitable source of income to many breeders, it is still a somewhat neglected branch of the industry. It is certainly capable of greater development and is a remunerative business when modern methods are used, provided the work is undertaken in close proximity to the market and is conducted economically.

Ducks are one of the quickest maturing birds we have. They are easy to rear, and there is a good demand for young fat ducks about ten or twelve weeks old. At this age the flesh is tender and realises a comparatively high price. Up to this stage the flesh is economically produced, and all ducks intended for table purposes should be sold at this age. Ducks are considered to be the hardiest of the inmates of the poultry yard, and the loss of ducklings should not be more than from 2 to 5 per cent. They are less subject to disease or insect vermin; they are easy to control in runs, and the equipment required is neither extensive nor expensive.

The farmer can feed ducks at a minimum cost, as one-third of the bulk of food for stock ducks may consist of vegetable leaves or other suitable green vegetation. If the farmer is a dairyman, the skim milk fed to ducks furnishes the best of nourishment at little cost, and if fed to growing ducklings will produce twice or three times the value it would if fed to any other classes of farm stock. Although there is a demand for well fattened ducks, duck eggs are not in as great demand, except fôr cooking purposes, as they should be, considering that their food value is as great as hens' eggs. They are a trifle richer and perhaps slightly less digestible, but they should be in greater demand than they are at present.

Breeds.—There are quite a number of wild and domesticated varieties of ducks. The best known breeds of the latter are the Aylesbury, Pekin, Rouen, Indian Runner and Muscovy. The less known varieties which are gaining popularity are the Khaki-Campbell and Buff Orpington. Other breeds are the Cayuga and the Crested Duck.

The Aylesbury.—This is a fine white bird with a long, broad, deep body carried horizontally—the keel practically parallel with the ground—with light coloured bill and bright orange shanks and feet. The flesh is solid and white. The Aylesbury is essentially a table duck and matures very quickly, the ducklings if properly fed and cared will weigh 5 lbs. to 6 lbs. in ten weeks. This breed is the favourite in England. Standard weights: Drake, 10 lbs.; Duck, 9 lbs.

The Pekin.—This is the favourite breed in America for both utility and exhibition purposes. It is not quite so long in body as the Aylesbury and the carriage is more upright. It is white in plumage, tinged with yellow or cream. The flesh is yellowish with a delicate flavour. The bill, shanks and feet are bright orange in colour. The eyes are dark lead-blue. Standard weights: Drake, 9 lbs.; Duck, 8 lbs. The Pekin is considered to be the best general purpose breed of duck. It matures fairly quickly, but is more active and a better layer than the Aylesbury, but not so useful for hatching purposes.

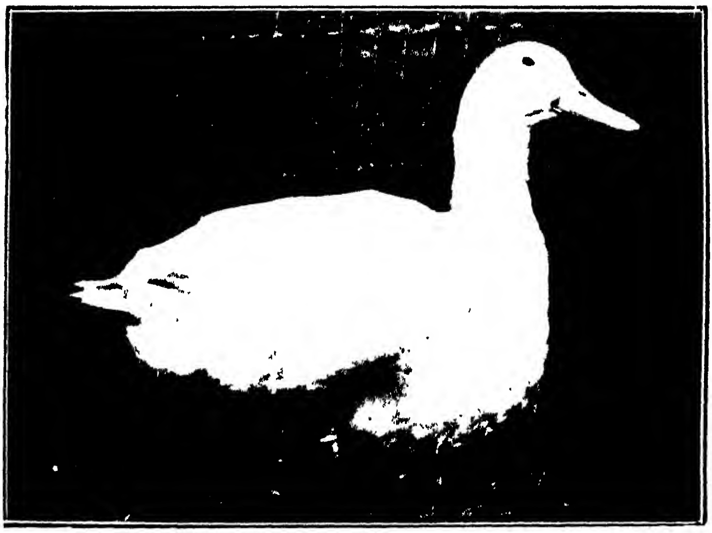
The Rouen.—This is essentially an exhibition breed, and is the most beautiful of all domesticated ducks. The type, size and carriage are not unlike those of the Aylesbury. They are generally slightly heavier and more ungainly in movement than the two previous breeds, and the skin is slightly dark in colour. In quality and colour of plumage it resembles the wild duck or mallard, and some strains are fair layers. The eggs are somewhat small as a rule. Standard weights: Drake, 10 lbs.; Duck, 9 lbs.

The Indian Runner.—This breed is essentially kept for egg production, being remarkably prolific layers of large, light coloured eggs of good shape. The two best known varieties are the white and the fawn and white. The body is long, narrow and racy-looking, the carriage being very erect, somewhat after the form of a penguin. Indian Runners

are hardy and are the best foragers. They do well without swimming water and are easy to rear. The standard weight of Drake is 5½ lbs. and the Duck 4 lbs. The weight of either sex should not exceed 5½ lbs. nor be less than 3½ lbs.

The Muscovy.—There are many of these in South Africa. They differ greatly from ordinary domesticated ducks in type and about the head. The colours vary from white with a black crest to black or black and white. The face is free from feathers, but fleshy and bright red in colour. The drake weighs about 10 lbs. and the flesh is medium dark in colour, but varies with the food they eat. They do not make good table ducks, except when young, and from a producer's point of view they are rather slow maturing. The size of the drake as compared with the duck varies greatly at the same age, which is a disadvantage for marketing. They are good sitters and fairly prolific. One point to note is that in this variety the eggs take five weeks to hatch as compared with four weeks in other varieties. Muscovies are also more difficult to control in runs, as they are good fliers.

The Campbell Duck.—This is somewhat like the Rouen in appearance but much lighter, with a plain head of a greyish-brown shade; the drakes have grey backs and a pale claret breast, and the legs are yellow. The original strain was developed from one duck which exhibited most remarkable laying powers, the object being to produce excellence in laying, with fair table qualities and quick maturity. They are not very large, stock birds weighing 4½ lbs. to 5 lbs., and in flavour they are said to considerably resemble the wild mallard, which was used in crossing as one of the foundations of the strain. The Khaki-Campbell is a sub-variety of this, and of more recent production. The Indian Runner has been used in crossing to produce this variety, and as a result the Khaki-Campbell duck is of extremely active habits, doing best on free range and showing very little desire for swimming. At whatever time of the year they are hatched, they are said to commence laying at six months old, and even sooner, so that by hatching three lots in the year, *i.e.*, very early, medium, and late, eggs may be obtained all the year round.



Aylesbury duck

Pekin ducks

Indian Runner ducks

Rouen Ducks

Buff Orpington Ducks.—This breed first came into prominence in England in 1908, when it was shown at several large shows. In Australia the breed had previously made its reputation by winning two twelve months' laying competitions in succession. It is intended to fill the demand for a first-class layer, combined with good table qualities. After crossing a number of varieties, including Indian Runner and Cayugas, some of the progeny showed a lot of blue in the plumage, and these were carefully selected and mated with pure-bred Cayugas and Pekins. These were selected and back-crossed until the Blue Orpington was standardised as in the case of the Buff variety.

In South Africa there are many crosses of the Aylesbury and Pekin, and both being, as they are to the casual observer, white, they are therefore much alike. Their distinguishing characteristics are, however, well marked, as will be seen from the following:—

	The Aylesbury.	The Pekin.
Body...	Deep and long.	Short and deep.
Colour of plumage	Pure white down to the skin.	White, with canary-yellow tinge, especially under the wings.
Head...	Rather flat and longer than that of the Pekin.	Deep, rounded and short from front to back, with prominent forehead.
Beak...	Pinkish or flesh-coloured.	Orange or yellow.
Carriage	Horizontal.	Upright.

It will thus be seen that there are distinct differences in the two breeds, and duck raisers should note this when buying or selling pure bred stock.

Housing.—The housing of ducks is not a difficult matter and does not require much detail. An open wire fronted low-built shed on sloping ground will prove satisfactory; 6 ft. high in front and 5 ft. at the back, 12 ft. long and 10 ft. deep will accommodate 50 adult ducks. As ducks are very susceptible to rheumatism and cramp, it is most essential that the roof of the house be water-tight or free from leakages.

The floor inside should be elevated above the surrounding ground and this should be hard, preferably made of cement, sloping gradually from back to front of the house, well littered and kept dry and clean by frequently renewing the litter. Wooden and earth floors are the least desirable, as they quickly become tainted and are difficult to keep dry and clean. The sides of the house need not necessarily extend to the roof; it is desirable to leave an opening three or four inches above the walls and below the roof for ventilation, as ducks like plenty of ventilation. Nest boxes are not required, a duck prefers to make its own nest on the floor. A few bricks may be provided and conveniently placed inside on the floor arranged in squares for the purpose. A wire netting enclosure 3 ft. high should be provided. It is advisable to keep the breeding and laying ducks away from swimming water until 10 a.m. or 11 a.m. during the laying season, supplying them with drinking water only for this period, otherwise they are very liable to lay their eggs in the water, which generally means a loss. An enclosure 3 ft. high is ample to confine them. Where possible, a water furrow through the yard would be of great convenience and save a lot of trouble as far as the water supply is concerned.

Selecting and Care of Breeders.—Vigour, quality and early maturity are the primary consideration in selecting breeding stock. Medium sized active birds are more satisfactory than larger ones, which may be coarse and consequently take longer to put on flesh and fatten. The ducks which are to be kept as future breeders should be selected when six weeks old. At this age a careful selection should be made by picking out the more advanced and promising ducklings, and these should be ringed and allowed free range with plenty of exercise to build up birds with vigour and well-developed frames. Early hatched, fully developed young birds generally make the best breeders; preferably a vigorous drake twelve months old mated to two-year-old ducks or two-year-old drakes with yearling ducks.

The question of how many ducks to mate safely to a drake is governed to some extent by the water supply. Breeding ducks must have water to swim in, but not necessarily deep water, in order to make sure of getting fertile eggs, although "dry" rearing has produced strains that breed

satisfactorily without water for swimming. It is better, however, to supply the heavy breeds of ducks with swimming water as a protection for their feet. If a running stream or water furrow through the yard is not available, a small pond 6 ft. square and 1 ft. deep with sloping sides in each pen will suffice for a breeding pen of six birds. The sides and bottom of the pond should be lined with cement and the water renewed at least once a week, according to the season of the year. A breeding pen may consist of three, four or five ducks and one drake, and the stock should be mated a fortnight before the eggs are needed for hatching purposes. In the event of there being an ample water supply and unlimited space, the breeding stock may be mated in the proportion of three drakes to twelve ducks at the commencement of the season, and as the weather becomes warmer the number of ducks may be increased to 18 or 20 with advantage. This system of mating applies more particularly to the duck farmer who raises ducklings for market. It is important that the male and females should not be too closely related if hardy, vigorous ducklings are required. Ducks may be bred from until they are three or four years old ,and the drakes to be mated to ducks of this age should be preferably two years old.

The breeding stock should be mated about May. Before setting large numbers of eggs or sending out to customers, it is advisable to ascertain the fertility of the eggs. As a rule the first eggs laid by young birds are apt to be infertile, though if the birds are well cared for and properly fed, the fertility quickly improves. It is customary, therefore, to test the fertility in an incubator or under broody hens until good results can be relied upon. Young ducks generally lay eggs in the early part of the season, and the older birds come on as the spring advances and as the weather becomes warmer.

Feeding.—The first essential for successful duck-raising is to provide food for the ducks at a reasonable cost at all times. Unless the animal and other concentrated foodstuffs can be obtained at a reasonable cost duck raising for market is likely to prove unprofitable. It is not so much the actual cost of food consumed by the growing ducklings themselves if disposed of early, as the cost of maintaining a large number

of breeding stock during the off season. It is on this account that the profitable raising of ducks depends upon efficient management and economical costs of production.

With reasonable care the feeding of stock ducks is not a difficult problem, provided the ducks are allowed exercise, either foraging about or swimming, which prevents them from becoming too fat. Ducks are somewhat large eaters and readily put on fat, so that with swimming exercise and judicious feeding the risk of an over-fatty condition of the birds may be reduced to a minimum. With good range, stock ducks do not require much food, as they would pick up a great deal in streams of water in the form of worms, grubs and weeds; in such circumstances a little mash in the morning and grain in the evening will suffice. It should be pointed out that ducks are gross feeders of vegetable and animal foods, even more so than fowls, and for best results these must at all times be supplied to them when kept in confinement or where they do not have access to streams of water. A deficiency of either of the above will retard the production of eggs. Another important item in the feeding of ducks is a liberal supply of oyster shell or lime during the laying season. In this respect ducks might be termed artificial birds, for if oyster shell is withheld egg production may cease entirely, and young ducks six months old will very often delay in commencing to lay if not supplied with oyster shell or well slaked lime. Ducks must also be supplied with grit. If at any time it is necessary to change the diet, this should be done gradually, as any sudden change of food may affect the fertility of the eggs, or will interfere with the production.

The following mash for adult stock and for ducklings retained for breeding from 6 weeks old is recommended:—

Bran	25 lbs.
Pollard	30 lbs.
Mealie Meal	10 lbs.
Animal Food	15 lbs.
Lucerne Leaf Meal	15 lbs.

The mash should be fed moist in a crumbly consistency in shallow trays or troughs. For adults give mash twice

daily when confined and a little whole maize in the evening. Cut green food should be supplied liberally. Add 20 per cent. by bulk to the mash at the time of laying.

A suitable ration can be made up by boiling meat scrap or offal when obtainable and by mixing the other ingredients so as to obtain a mash of crumbly consistency. Lime and oyster shell is important for laying stock.

The best grain foods for stock ducks are wheat and oats; whole or crushed mealies will prove satisfactory, if not supplied too liberally. The grain food should be fed in water in a pond or large shallow vessel containing water. This method of feeding the grain is the most natural and the ducks are better able to pick up the food and enjoy it. Oyster shell and grit should be given in the same way, which will keep the ducks occupied in searching and will encourage them to exercise.

Incubation.—If duck eggs are slightly more difficult to incubate than hen eggs, the duck raiser has one consolation, in that ducklings are more easy to rear than chickens. Duck eggs intended for hatching should be carefully stored to prevent evaporation, and the fresher they are when set the better. They may be set either under ducks, hens or in an incubator. Ducks, however, usually make indifferent sitters and worse mothers, and they are more difficult to control and handle than hens.

The condition for the successful hatching of duck eggs are similar to those employed with hen eggs, except that duck eggs require a lower temperature, namely, 102 to 102½ degrees F. at the commencement, and after the second week a temperature of 103 to 103½ degrees F. would do no harm to the embryo ducklings. It should also be remembered that duck eggs require more moisture than hen eggs do. The egg shell of the former being thinner and more porous, evaporation of the contents is greater and more rapid in dry weather. It is necessary to spray the floor of the incubator room with water during the dry weather in addition to the moisture supplied in the water tray of the machine. When broody hens are used for hatching purposes, moisture can be supplied by digging a hole two feet deep and two feet in

diameter where the nest is to be placed. Pour in four or five gallons of water and replace the soil, and when the hole is filled up make a concave depression in the loose soil and line with clean straw or grass; the nest is then ready for the eggs. The eggs will not require additional moisture unless the weather is very dry and windy, when they may require sprinkling with tepid water during the last week of incubation. The incubation period of duck eggs is 28 days, during which time the eggs should be tested twice, namely, on the seventh day and again on the fourteenth day of incubation.

Ducklings when hatching generally chip the shell twelve to thirty-six hours before making their exit, during which time they are absorbing the remaining yolk for their support after hatching. When necessary to open the incubator drawer, the chipped part of the eggs should be turned upward. If this is done quickly, gently and without too long exposure, and if the ducklings are not hatching out easily, the fractures should be examined to see if the lining membrane of the eggs is too tough. If so, a little discreet assistance by opening the shell without causing bleeding may help matters. It is not advisable, however, for the incubator to be opened at hatching or any other time oftener than is absolutely necessary, that is to say, twice daily about twelve hours apart. Ducklings are longer in getting clear of the shell than chicks, therefore the operator should not be unduly anxious. It is important to maintain the temperature in the machine, as there is great danger of chilling wet and half dry ducklings.

During the time of hatching there should be ample moisture in the egg chamber, so much that it will condense at the ventilator holes, or in some machines on the observation glass of the door. If the orifice made by the ducklings in the shell dries, the duckling may become attached to it and thus unable to make its exit. When the hatch is well advanced the ducklings should be taken from the drawer and placed in the drying box or in the nursery below the egg tray. This should be done in the morning, the dry ducklings only being removed to the drying box or nursery, where they should remain for twenty-four hours after the hatch is complete and then removed to the brooder.

Rearing and Feeding.—The future of young ducklings depends first on the stamina and condition of the breeding stock and next on how they are treated during the first ten days of their existence. As a general rule ducklings require less warmth than chicks, but they must be kept dry. They can be raised very satisfactorily in cold brooders similar to those used for brooding chicks. Attention should be drawn to the fact that young ducklings are very susceptible to sunstroke and they should have access to plenty of shade. For young ducklings a small run covered on top to supply shade is desirable for this purpose. After a week old the ducklings need not be strictly confined to the hover during the night in warm weather. During moonlight nights especially they usually make periodical visits to the food trough, in which dry mash should be placed. A shallow vessel containing water must also be accessible and should be placed a little distance away from the dry mash. This practice is a very desirable one and should be encouraged; as by this means the ducklings will make remarkably quick growth, which is essential for market ducks. The first feed should consist of fine grit, which should be given in the drying box of the incubator; and when removed to the brooder a little grit may also be placed in a shallow vessel containing drinking water. When the ducklings are 24 hours old they will be ready for their first feed of mash, which should be moistened with skimmed milk or warm water. The food must be crumbly when damp, not sticky nor too wet.

Ducklings must be fed frequently and regularly during the first few days. Do not on any account allow the food to lie about and become stale and sour, as this will prove very harmful to the ducklings. The ducklings which make good vigorous growth and show symmetrical development should be selected for next season's breeding, and at six weeks old they may be separated from those that are intended for the market and fed on the ration for adult stock with a view to robust development. Place them in a large, well-shaded enclosure to develop naturally, and at eight weeks old allow them to have free range under suitable conditions. After the breeding season they may be turned out with the older ducks to forage about for most of their food.

The ducklings that are intended for the market should not be allowed access to swimming water. At the age of six or seven weeks, when their frames are sufficiently developed, they should be confined in a small enclosure without over-crowding and the process of fattening begun. The following rearing and fattening mixtures should prove satisfactory if moistened with water or milk.

	First 6 weeks.	After 6 weeks' fattening.
Bran	15 lbs.	10 lbs.
Pollard......	40 lbs.	20 lbs.
Mealie Meal	30 lbs.	45 lbs.
Meat Meal	10 lbs.	15 lbs.
Bone Meal	2 lbs.	3 lbs.
Salt	1 lb.	1 lb.
Lucerne Meal	5 lbs.	10 lbs.
Cut Green Food	At 10 days old	10% by bulk.

Ducklings may be supplied with a little finely cut green food from 10 days old until 6 weeks of age, then succulent green food should be increased giving 10 per cent. by bulk mixed in the mash after six weeks old. Feed the mash at regular intervals four times daily for the first six weeks, then three times daily until marketed at 10 to 12 weeks old. The ration for fattening ducklings may be cheapened at certain seasons of the year by adding boiled mashed potatoes and sweet potatoes or pumpkin to the extent of 30 per cent. after six weeks of age.

They must have a constant supply of drinking water and grit, and, of course, they must have shade. It is better to leave them a little hungry than to over-feed them. Fifteen to twenty minutes is time enough for ducklings to eat all they should three times a day, and whatever is left should be removed. Ducklings fed in this way should weigh 5 lbs. to 6 lbs. at ten weeks old.

Do not keep them longer than twelve to thirteen weeks of age. This should be the limit, as they then develop their adult plumage and pin feathers. During the next six weeks

they will require a lot of nourishment for development with the result that the ducklings do not make economical gain in weight. The food they consume during this period would add so much to their cost that instead of showing a profit they would show a loss.

An effort should be made to commence hatching as early as possible in the breeding season, and produce consecutive batches of ducklings for market throughout the season.

Send to the market birds of the same age and as near as possible the same size and value so that a standard quality can be established. This is one of the most important factors in a regular and profitable market.

Bugs and beetles take their toll
but
Cleanliness Aids Insect Control.

The Management and Utilisation of Natural Pastures

By H. C. ARNOLD, Manager, Salisbury Experiment Station.

Note.—The information given in this article is largely based on the investigational work which has been conducted at the Agricultural Experiment Station, Salisbury, during the past eighteen years. These observations are supplemented by those of workers in the Union of South Africa, to whom grateful acknowledgements are due. It has been written in the hope that, pending further locally conducted research work on this problem, it will serve as a guide to those who desire information concerning the methods which may be adopted to increase the stock carrying capacity of the natural pastures. It is hoped that the practices recommended will replace the haphazard methods which have been commonly followed in the past which, if continued, will result in the deterioration of the pastures, loss of productivity, and their ultimate destruction.

Introductory Remarks.—The comparatively small monetary return received for animal products when they are exported from this Colony compel the use of feeding materials which are obtainable at low cost. Nature has provided an abundant supply of very cheap food in the natural veld; but, with the exception of a few months during the rainy season, the feeding value of this herbage is too low to produce high quality exportable beef. On the one hand, therefore, we have a market which demands a steady supply of high quality beef, which is obtainable only from animals which have received sufficient nutriment every day of their lives, and on the other hand, cheap natural pasturage of the required feeding value, available for short periods only. The bridging of the gap between the periods of natural abundance, by the provision of food of suitable quality at low cost, is thus seen to be the feeders' main problem. The feeding of crop residues may solve this problem in the case of farmers who cultivate large areas, but it is the purpose of these notes to direct

attention to the merits of the grass crop as an economical source of cheap food for farm livestock, and to suggest ways and means for its better utilisation.

There is a tendency among cattle owners to ignore the requirements of their pastures, and for these to receive scant consideration while the cattle are healthy and in good condition as a result of their getting an abundance of young grass. In the first stages of veld deterioration the cattle may thrive extremely well, because they keep the grass eaten down and the resulting growth is all high in nutrient constituents. If the veld is continuously overstocked, however, the sleek condition of the cattle will be obtained at the expense of the vitality of the grasses. After a few years the farmer finds that, although the cattle maintain their condition during the rainfall period, there is not sufficient grass to carry the herd as far into the winter as in former years; and when a droughty season is experienced there is a serious shortage. Although short young grass is necessary for the welfare of the livestock, and this may be obtained on virgin veld by stocking heavily, if that practice is continued too long the cropping power of the sward is reduced, and harmful effects to the cattle will follow. A balanced system, in which the welfare of the grass receives consideration as well as that of the livestock, must be worked out, in order that the fullest use may be made of the herbage, without impairing the productivity of the sward.

The limitations of the veld must be kept in view; and if it is found that the natural pastures are unable to provide sufficient food for the livestock within a margin of safety, the necessary steps must be taken to increase the supply by the establishment of artificial pastures or by other means. Although on parts of the farm which are ploughable it may be possible to rectify past mistakes by laying down artificial pastures, on those parts which cannot be ploughed, irreparable damage may be done by mismanagement before the true state of affairs is realised. It must be remembered also that the best grasses for the establishment of artificial pastures are native to this continent—with the possible exception of paspalum for vlei lands—and unless these pastures receive the attention they require to ensure their productivity and persistency, they also, will deteriorate until they produce

little more than the veld which preceded them. It may be assumed, therefore, that systems of management, similar to those required to increase and maintain the productivity of natural veld, are best suited for artificial pastures also.

Veld Management.—Although there are certain general principles which are applicable to all types of grasslands, it is impossible to lay down definite rules for veld management which will be applicable to the Colony as a whole; because the factors which influence the growth of the grass such as soil, rainfall, species of grass ,etc., vary so widely in different districts, or even on different farms, that methods will need to be modified to suit the various conditions. Nevertheless, in all cases the object will be the same, *viz.*, to make the best use of the herbage, and to maintain and, when possible, increase the productivity of the sward.

In order that the correct methods of veld management may be evolved, it must first be realised that the grass exists primarily for itself, and not for the benefit of the farm stock, locusts, army worms and other natural enemies. Nevertheless, like all other forms of Nature, it plays its part and makes its contribution to the welfare of the whole. The natural veld consists of numerous kinds of grass, as well as a number of other plants, and these differ in their degree of usefulness. Among them are certain species which are more highly valued than the others, because their foliage is more palatable to farm animals and it is produced in larger quantities than that of some of the other species. It behoves all graziers to ascertain which of the many kinds of grass comprising their veld are the most productive and palatable, and to take precautions to prevent them from being destroyed by mis-management. The veld may be regarded as a mixture of several kinds of crops and weeds. The requirements of each of these crops differ somewhat from those of the others. Continuous competition for soil nutrients, moisture, space, sunlight, etc., takes place between the various members of the plant population; and when changes are made which are beneficial to the development and propagation of certain groups of these plants, the other groups will usually be adversely affected. For instance, during seasons in which the rainfall is above normal, the tall robust grasses are favoured, but their dwarf

competitors are not benefited to the same extent, and may, indeed, receive a setback. Similarly, light grazing encourages the growth and propagation of the tall, seed-producing grasses, while moderate stocking and mowing favours the dwarf and creeping kinds. By means of grazing, mowing, cultivating and applying manures, using the herbage or refraining from using or burning it, changes in the proportion of the various species of plants comprising the sward can be brought about. Whether the changes effected will be found advantageous or not, will depend on whether these methods find their proper place and proportion in the system of management.

The lifetime of the grass plants varies greatly among the different species. The "annuals" exist for a few months only, others live for a few years. The veld grasses may be roughly divided into three classes according to their method of reproduction, *viz.*: (1) Those which depend entirely on seed. (2) Bunched or tufted species which produce seed in greater or lesser quantities but which also reproduce themselves by means of short underground off-shoots. (3) Those which depend mainly on creeping runners which establish new plantlets at a distance from the parent plants. Class 1. This includes all the annuals and some perennials. Class 2. Apart from the new plants which may arise from their seed, the species belonging to this class reproduce themselves by the repeated formation of new sideshoots. These reach maturity and die off in the course of a few years in much the same way as the individuals which comprise a clump of banana plants. Although the tufts of grass may persist for many years, the lifetime of the plantlets of which the tuft is composed does not usually exceed three or four years. Class 3. The creeping runners, which form the means of reproduction of this class of grasses, are usually found above ground; but some species have them below ground, while in a few kinds they are found both above and below the surface. With few exceptions grasses belonging to this group do not produce much seed. It includes many of our most valuable pasture grasses. As a rule, these are more persistent than those which belong to the other groups, but they are migratory. In the natural sward the old plants weaken and are ousted by younger plants which are usually of another species; but the creeping

runners extend in all directions and establish new plants as they proceed, and in that way the reproduction of the species continues. It will be seen therefore that, although some species live longer than others, none of the grass plants live for more than a few years, and this must be taken into account when the system of management is planned. It is obvious that it will be necessary to allow for periods during which the energy of the plants may be directed towards the propagation of their kind.

It must be realised that the grass plants cannot maintain their vitality and productivity unless growth takes place underneath the surface of the ground as well as above it. The root system needs to be extended, the worn out parts must be renewed, and the materials for this additional growth have to be "manufactured" in the leafy parts of the plant. Furthermore, when defoliation is severe, the plants have, perforce, to use reserve material from their roots to make new leafy growth. It is self-evident, therefore, that when the new growth is repeatedly removed at short intervals, the roots cannot be adequately nourished, and if the practice is continued the root system will eventually be starved and the whole plant destroyed.

When farm livestock are allowed to graze the veld without control they will graze off the sweetest and most palatable grasses at more frequent intervals than the less palatable ones; and, unless the veld is understocked, the best kinds will be heavily handicapped in their struggle against their aggressive but less valuable neighbours. By controlling the grazing a larger proportion of the total herbage can be made use of, competition between the best and the second-best species can be equalised, and in some areas the productivity of the veld can be considerably increased.

The intensity of the grazing cannot be controlled effectively until the farm has been divided into camps. The size and number of camps will be governed by such factors as the value of the land, financial position of the farmer and also the class of cattle kept. In some areas it may be found that the grass types on the farm vary from place to place, and in such a case the camps should be arranged, as far as practicable, so that the different types occupy separate camps.

Due regard must be paid, of course, to the provision of drinking places and shelter from cold winds. Everything possible should be done to facilitate the adoption of measures of grazing control best suited to each type of veld or each dominant type of grass.

The pastures may then be divided into three main groups.

(1) Areas which will be grazed during the summer months.

(2) Areas whose herbage will be mown off and preserved for winter use.

(3) Areas which are being recuperated by "resting," or are being laid down to artificial pastures.

In some districts there will be areas where the grasses are winter palatable, and these may be reserved for use at that time of the year. The proportion of vlei pasture to hill pasture will also exert considerable influence on the system of grazing control. A rotational system should be arranged, in which, so far as it is practicable to do so, the various summer treatments will be applied to all the different areas in successive seasons. Hence areas which are grazed during the summer in one year should, when possible, be reserved for hay during the next season, and periodically the pastures should be allowed to rest throughout the summer without being grazed at all until after the grasses have produced seed and this has fallen to the ground. In practice, modifications of this three-course rotational scheme would probably need to be made, *e.g.*, stony land could not be mown for hay, but in the first year it could be grazed in the early summer and again in the autumn, in the second year it could be grazed during mid-summer and winter, and the following year allowed a complete rest if necessary until the grasses had produced and shed their seed. On some farms it might be found necessary to mow the same areas for two or more years in succession, and so on; but a rotational system could be evolved in which the grasses would be grazed or mown at different periods in successive years, and at suitable intervals a summer resting period would be provided for the purpose of allowing the grasses to propagate themselves, colonise bare spaces, and replace old worn out plants with young, vigorous seedlings or plantlets according to their method of propagation.

The type of veld will determine the length of the grazing and mowing period between complete summer rests which can be most economically employed. It is thought that veld which consists mainly of palatable, tall, seeding species, will need to be rested every third or fourth season when it is desired to retain these species, but the quality of the herbage on parts of the veld on which unpalatable, tall, stemmy, free-seeding grasses predominate may be improved by mowing at the time when these grasses are flowering. The mower should be set high, so that a comparatively small amount only, of the creeping, and leafy types of grass is removed. The "after-math" is then grazed off during the early winter months. By this means the leafy types are partially rested every year; the removal of the tall grass lets in the sunlight to the dwarf species and enables them to flourish and propagate their kind. On the other hand the stemmy and less valuable grasses are prevented from seeding, and the proportion of these in the sward is gradually reduced. A farmer who mowed and grazed his veld in the manner described informed the writer that the association of grasses comprising those areas was entirely changed in the course of a few years, and its stock carrying capacity was doubled. Veld in which the creeping grasses predominate will maintain its vitality for a somewhat longer period than that which consists of seeding species, provided that it is not summer-grazed too severely in the meantime.

Swards which consist mainly of the couch grasses which spread by underground runners, can be rejuvenated by loosening the soil with a plough or other suitable implement during the early part of the rainy season. The entrance of air into the soil will promote bacterial activity and this will release plant nutrients which have hitherto remained locked up in the old root systems. The new shoots and roots which follow will make use of this released fertility and a rejuvenated pasture will result.

Experiments conducted at Potchefstroom, in the Western Transvaal, showed that grazing veld during the winter months after a complete summer rest had a beneficial effect on the germination of the seed in the following season; and it appears that the tramping of the cattle helped to cover the seed. Then, by refraining from grazing until well after mid-summer, the seedling grasses were enabled to become firmly rooted before

encountering the depressing effect of defoliation. In this Colony the seed of many of the grasses ripens and falls in the latter part of the month of February, and some of it germinates during March and April. In seasons in which the rain continues until April, a small proportion of these grass seedlings develop a root system which is large enough to enable them to battle against the drought and heat of the period which intervenes between the seasonal rains. A part of the seed crop remains dormant until the next season, and the plantlets which result have a better chance of surviving than those which germinate at the end of the rainfall season. The seed crop of a number of species is immature when it leaves the parent plants and portions of it mature at varying intervals over a period of several years. Hence the portion which reaches maturity within a few months of the time it is shed, germinates as soon as favourable climatic conditions arrive, but the other portion will not mature until one, two, three or more years have passed, and in this way separate germinations from the same crop of seed will be spread over several successive seasons. In other species the seed is enveloped in tough coverings which have to be partially worn off by abrasion in the sand before the moisture which promotes germination can gain access to the seed. The seeds of other species are equipped with bristles and awns whose function is to bury the seed in the ground. By these and other means nature has provided against the possibility of her efforts being rendered entirely unfruitful through a single simultaneous germination of seedlings encountering unfavourable climatic conditions, an invasion by insect pests or other adverse events. In their efforts to rejuvenate the sward, the grasses have several difficulties to contend with, among these are the various fungi which attack the seed heads, *e.g.*, smut and ergot; chewing and sucking insects which destroy the half ripe seeds, grain eating birds, termites, rodents and other livestock which devour the ripened grain. With so many enemies to battle against, it is apparent that the grasses should receive attention and assistance from those who benefit from their products, and it behoves every pastoralist to examine his management methods, to observe their effect on the composition and density of the sward, and decide whether his actions are those of a friend or a foe of the veld.

Unless the farm is much understocked, it will be advisable to practise short period grazing on the summer pasture areas in order that the evil effects of the selective grazing of patches of the most palatable grasses may be avoided. Investigational work that has been conducted at institutions in the Union of South Africa has shown that an interval of about two months between defoliations is required by the majority of the hill types of veld grasses in order that they may recover from the effects of being cut down during the summer growth period. This indicates that the grazing camp should be temporarily divided into comparatively small areas which can be completely grazed down within a few days, after which the livestock should be moved to another area, and so on. These areas should not be grazed again until a period of approximately two months has elapsed. In practice it might not be found possible to adhere very closely to this two monthly system of grazing, but the harmful effects of short-interval grazings must not be lost sight of. It is thought that the recently introduced method of fencing with electrified wire may prove to be of considerable value to farmers by enabling them to make temporary enclosures for a small cash outlay.

If patches of coarse grass are left ungrazed, these should be mown off as soon as the animals are moved to a new area, in order that the unpalatable species may be prevented from seeding and that the young growth which follows will be accessible to the cattle when they return to graze that area again.

Of all the troublesome grasses of the veld, *Sporobolus pyramidalis*, or Catstail, is the most aggressive. It spreads rapidly on land which is much tramped and overgrazed, and in extreme cases it completely ousts the more valuable species. On moderately grazed veld it is found along the cattle tracks, around termite mounds, etc. Its foliage is tough, and is not readily eaten by cattle when other grasses are available, so that during the summer months it flourishes unchecked, and produces numerous seed heads which contain a large amount of virile seed. The mature seed is very palatable to cattle and they eat it greedily, but a proportion of this seed is not digested and it is distributed wherever the cattle go, resulting in the establishment of the grass wherever suitable conditions are found.

Although it produces green growth both earlier and later in the season than the common veld species and is appreciated by cattle at these times its foliage is not very nutritious, and most farmers consider that it possesses little value as grazing and is therefore an undesirable species. The best way to prevent it from spreading is to mow it before the seed ripens. Two or three cuttings during the course of the season may be found necessary, because its growth continues over a long period and successive crops of seed heads appear. Where the sward consists almost entirely of sporobolus it may be found possible to keep it down by grazing with livestock, but care should be taken not to spread it on the clean veld by means of cattle which have recently eaten the seed. There are indications on the grass plots at the Salisbury Experiment Station that sporobolus cannot establish itself in competition with other pasture grasses when they are in thrifty condition, and the sward forms a reasonably dense covering over the soil. The weakening of the other grasses through tramping, over-grazing, termite attack, etc., creates conditions suitable for sporobolus to obtain a place in the sward.

Preserving Fodder for Winter Use.—The necessity for preserving fodder for use during the winter and early spring months is recognised by the majority of cattle owners, but many fail to make provision for a protracted winter and few gather all the available grass during seasons of plenty with a view to keeping some for use during a future season of scarcity.

Young grass is much more nutritious than old grass, and for that reason it should be cut as early as possible or it will have little value as feed. On the other hand, it is necessary to delay cutting until the sward will yield enough fodder to more than compensate for the expense involved. In order to obtain the requisite quantity and quality it has been found that the grass should be cut when it is in the flowering stage; and, in most species, this occurs during the latter part of January and early in February. Some farmers affirm that it is impossible to make hay at that time of the year because of the inclemency of the weather. In this Colony there are few seasons in which the wet weather is so continuous as to

render hay-making entirely impossible, but there is also the difficulty of protecting the hay stacks from rain, fire, termites, etc.

The labour required to build suitable barns, or even to build and thatch stacks effectively, is not readily available on the majority of the farms in this Colony; and it would appear that the preservation of the grass as silage might be found the more economical method for that portion of the pasture which it is intended to preserve for more than a few months. Although, when the sun shines, dry grass as hay can be gathered and stacked with somewhat less expenditure for labour than can "wet" grass as silage, there are advantages in silage, the making of which should not be overlooked, *e.g.* (1) silage-making is less dependent on weather conditions than hay-making, and this permits of the gathering of the grass crop while it is young and nutritious, with the certainty that it can be safely stored for an indefinite period. (2) It requires less skill to dig or scoop holes in the ground, and after they are filled to cover the fodder with earth to protect it from nature's destructive elements, than is required to build sheds or even stacks which can be efficiently thatched to provide complete protection. For this reason the silage method of preserving grass which is cut early, or is to be kept until the following season, may be found to be more economical than its preservation as hay, when the work has to be performed by unskilled labour. (3) When there is difficulty in providing sufficient water for the livestock, silage will help to solve the problem, because the grass silage made from each acre will provide from 300 to 600 gallons of water. On most farms there will be reasons for making both silage and hay.

Trials recently conducted in Natal have shown that in sunny weather it is possible to cut, gather the wilted material, and pack it into loose bales within the space of a few hours. The bales are stacked with air spaces between, and temporarily roofed until the curing processes are completed. By this means, hay which contains a high proportion of protein can be obtained, and it has a feeding value which is high enough to maintain cattle in fairly good condition throughout the winter months, without the addition of concentrates. Another method of curing hay during protracted spells of wet weather is by the use of tripods made of light poles about six feet high.

Cross-bars of about the same length placed horizontally, 18 inches from the ground, keep the slanting legs rigid; and one or two hoops of wire between the cross-bars and the top may be found necessary when short material is being handled, to prevent it from falling between the legs. The wilted grass is placed around the tripod to form a small stack with a hollow centre. The ventilation of the stack will be improved if the horizontal cross-piece project about 18 inches beyond the tripod legs to keep the material off the ground at those points and so facilitate the entrance of air to the centre of the stack. Sufficient ventilation is thus provided to prevent injurious heating, and although rain may penetrate for several inches into the material, the support afforded by the tripod prevents the wet grass from settling too closely, and it soon dries again after the storm has passed. It is seen, therefore, that farmers who wish to preserve their surplus grass while its feeding value is high, have a number of methods to choose from. Furthermore, the crop of grass which follows the mid-summer hay crop will be more nutritious than that of the whole season's growth, and will be of great value for autumn pasturage. In addition to the hay which is cut at mid-summer, high quality hay can be obtained by closely grazing the veld during the early summer, and then reserving the grass until the autumn, when it can be converted into hay, and there is little likelihood of rain interfering with the work. Vlei pastures are particularly useful for winter and early spring grazing, but during the summer months the cattle prefer the sweeter grasses found on the hills, and the growth on the vleis is left to become coarse and unpalatable. In such cases the removal of the coarse growth during the late summer, even if it can only be used as bedding, is worth the trouble, because the autumn growth of new grass will be made accessible to the livestock, and will provide nutritious food at a time of the year when the pastures on the hills are rapidly losing their productivity and nutritive value.

It is apparent, therefore, that the mowing machine can be of great assistance in the management and utilisation of pastures. It can be used for three purposes, namely: (1) to enable the storage of surplus fodder for future use; (2) to facilitate the removal of growth which, if allowed to remain, would become coarse and valueless as fodder, and also render

subsequent young nutritious growth inaccessible to the livestock, except in adulteration with old grass; (3) it can be employed to off-set the evil effects of selective grazing by the livestock. By cutting down the coarse grasses, weeds, etc., their growth and seed production may be retarded; they then receive a check to their development comparable with that imposed on the palatable grasses which have been grazed down. By this means the best grasses can be assisted in their struggle with the less valuable members of the sward.

Grass Burning.—The devastation caused by uncontrollable grass fires which sweep across the veld during the rainless winter and spring months is apparent to all observant persons, anu it is not necessary to reiterates here, the warnings frequently given about this phase of the question. Although it is a bad master, fire can be made to serve useful purposes in veld management, chiefly for removing surplus old grass which would definitely prevent access by the livestock to the new growth, and as a means of checking the vitality of grasses whose growth becomes wiry and unpalatable early in the season.

When the veld consists almost entirely of winter palatable grasses, such as the *Urochloas* and *Panicums*, and the livestock are numerous enough to consume the greater part of the growth, burning may never be necessary. On the other hand, when the veld is comprised of tall 'thatch grass'' types, whose growth has matured unchecked by grazing animals or the mowing machine, the only practicable method of restoring its value for pasture is by burning off the useless coarse growth. Between these two extremes there are numerous gradations in types of veld, in which sweet and sour, fine and coarse species are mixed in different proportions. When the bulk of the growth has already been removed by the mower or the grazing animals, there is nothing to be gained by burning the grass which remains, because it forms a very valuable protective blanket for the soil, which reduces the drying effects of sun and wind, and the eroding power of heavy rain, but it does not prevent access by the livestock to the new growth. In general, therefore, when the area which has been grazed down by the livestock exceeds 50 per cent. of the total, burning the remainder is not advisable, excepting perhaps when steps can

be taken to restrict the fire to the ungrazed areas. When more than half of the veld is covered by grasses which are coarse, sour or unpalatable to livestock for any other reason, the stock-carrying capacity of the area will be reduced if the useless material is not removed. Whether it will be advantageous to burn or not, will depend on such factors as the type of veld, the number of stock to be grazed, whether it was burned in the previous season and whether it is desired to rest the veld to allow the grasses to produce seed.

In addition to its employment for the removal of useless material, fire can be used for the suppression of undesirable forms of vegetation. Nearly all kinds of grass are palatable to livestock in the early summer, but their growth is so rapid during the rainy season that the livestock are unable to eat it all, hence they graze only on the patches which contain the succulent kinds, leaving the less palatable grasses to grow unchecked. If this is allowed to continue for a number of years it may eventually result in the elimination of the more valuable species and the propagation of those kinds which quickly become tough and wiry. Much can be done to check the increase of the wiry grasses by burning the patches with heavy growth, but leaving the grazed patches unburned. To accomplish this, the firing must be done when conditions are favourable, such as during a calm evening, or a few hours after rain has fallen, when the short grass will not burn. Thus the useless old grass may be removed, but the protective cover on the grazed areas will be retained. The young growth of the wiry species which later appears on the burnt areas will be eaten down closely, while that on the unburnt patches will be less severely grazed. In this way the patches which are left ungrazed in the previous season may be made to contribute towards the grazing during the next season, while those of sweet grasses, which were overgrazed before, will have a better chance to make normal growth, and recover somewhat from the effect of previous maltreatment. The close cropping of the young growth of the wiry species reduces their vigour, production of seed, and ability to compete with the other grasses; but the full benefit to be derived from this method of veld treatment will not accrue unless it is combined

with periodical resting to allow the sweet grasses to produce seed, and by this means spread to the areas previously occupied by the less valuable species.

In certain bush veld areas in parts of the Union of South Africa it has been observed that withholding fire, in conjunction with overstocking, has resulted in a large increase in the number of thorn bushes, and the consequent ousting of the pasture grasses. The increase of thorn bush is believed to be due to this overgrazing combined with the absence of fires; and it is thought that on veld of that type the most economical way to prevent thorn bush from spreading is to refrain from grazing for a season or two, and to fire the resulting growth of grass when the conditions are such that a maximum amount of heat will be generated and by that means destroy as many thorn bushes as possible. In this Colony, however, where labour can be obtained at comparatively cheap rates, it might be found more economical to grub up the trees rather than to forego the grazing for two seasons, and then only effecting a partial destruction of all but the smallest bushes.

At Cedara in Natal, carefully conducted experiments showed that periodical burning of the veld was necessary to ensure the vigour and dominance of the most useful natural grass found in that locality, namely, red grass, or *Themeda triandra*, var. Burchelli. It was found that when fire was withheld for more than two seasons, other less valuable grasses made their appearance. The average annual rainfall at Cedara is 36 inches, and it is spread over a considerably longer period than the rainfall in this Colony, excepting for the mountainous parts along the Eastern Border, and, so far as this Colony is concerned, it is only in those districts that the Cedara results are likely to be applicable. Climatic conditions over the greater part of Southern Rhodesia are more similar to those of the Western Transvaal than those of Natal. Investigations conducted at Potchefstroom into the effect of burning the whole of the veld each year for a period of six years showed that it caused an increase in the proportion of bare ground from 5 to 45 per cent.; also the wiry species of grass increased, and there was a proportionate decrease in the palatable species. The effect was equally harmful, whether the burning was done in June or whether it was delayed until

September in each year. These results indicate that the Rhodesian species of *Themeda* and other palatable grasses are not likely to be benefited by annual burning; and furthermore, that it is most important to take adequate precautions to prevent the indiscriminate firing of the veld, and that this should only be allowed when here is a definite purpose in view.

Applications of Chemical Fertilisers to Veld.—The yield of veld herbage may be increased by applications of fertilisers. Those which supply nitrogen are the most effective; but, as a general rule, the increase of fodder obtained does not justify the expense involved, except perhaps, for dairy farmers or others who obtain relatively high prices for their products. It is obvious that the fertiliser falls on the weeds as well as on the useful species in the sward, and although certain members of the veld flora do not respond to the increased fertility on certain types of veld, some of the unpalatable weeds and grasses are benefited by the fertiliser, *e.g.*, Mexican marigold, *Sporobolus* spp. These flourish, unchecked by the livestock, while the vigour of the more nutritious and palatable species is depressed through defoliation by the grazing animals. For these reasons applications of fertiliser to the natural veld should only be made on an experimental scale at first. If the resulting growth is found to justify larger applications, they can then be made to areas which are found to give the largest response. The results of experiments conducted on a large scale indicate that profitable returns will usually only be obtained from areas on which the grass population consists very largely of palatable species.

From the information given it will be possible to formulate schemes for the management of pastures and the preservation of their fodder, which will enable cattle owners to maintain their herds in good condition throughout the year, and only those which are to be finished off for slaughter will need supplementary feeding.

Summary of the Game Laws of Southern Rhodesia

AS AT 1st MAY, 1939.

Owing to changes which have been effected in the Game Laws and in consequence of requests for information, the following is published in a summarised form:—

CLOSE SEASONS for game are:—

(1) *Ordinary Game* (exclusive of duck and geese)—

Throughout the Colony from 1st October to 30th April.

All ducks and geese—

Throughout the Colony 1st May to 31st October.

(2) *Special Game*—

Throughout the Colony from 1st December to 30th June.

DEFINITIONS.

Ordinary Game.—Duiker, steinbuck, Sharpe's steinbuck (locally known as grysbok), klipspringer, warthog, gnu or wildebeeste, francolin (including pheasant and partridge), sand grouse (Namaqua partridge), Indian partridge or Chikor, guinea-fowl, all duck and geese.

Special Game.—Buffalo, zebra, reedbuck, bushbuck, koodoo, sable, waterbuck, lechwe, pookoo, impala, tsessabe (in the native districts of Sebungwe, Lomagundi, Wankie, Insiza, Belingwe, Chibi and Gwanda only), Lichtenstein's hartebeest (in the native districts of Ndanga and Bikita only).

Royal Game.—Elephant (only those with tusks exceeding 11 lbs. in weight each), rhinoceros, giraffe, eland, roan, gemsbuck, inyala, situtunga, hippopotamus, Lichtenstein's hartebeest (in all native districts except Ndanga and Bikita), tsessabe (in all native districts except Sebungwe, Lomagundi, Wankie, Belingwe, Insiza, Chibi and Gwanda), ostrich, rooi or Cape hartebeeste.

The following birds and animals are protected throughout the Colony.

(1) All species of storks (*Plataledae Ciconiidae, Scopidae* and *Ephippiorhynchus* (Saddle billed stork).

(2) Normann's pratincole (*Glareola melanoptera*).

(3) All species of egrets (*Herodias*) and the cattle egret or tick bird (*Bubulcus ibis*).

(4) Wattled starling (*Dilophus carunculatus*).

(5) The dikkops (*Oedicnemus*) and all species of plover (*Charadriidae*).

(6) All species of cranes (*Gruidae*).

(7) All species of owls (*Strigidae* and *Bubonidae*).

(8) The standard-winger nightjar (*Cosmetornis vexillarius*).

(9) All species of bee-eaters (*Meropidae*).

(10) All species of rollers (*Coraciidae*).

(11) The narina trogon (*Hapaloderma narina*).

(12) All species of flamingoes (*Phoenicopteridae*).

(13) All species of Ibis (*Ibididae*).

(14) All species of Orioles (*Oriolidae*).

(15) All species of sunbirds (*Nectarinia, Cynnyris, Anthothreptes*).

(16) All species of bustard (*Otidae*) commonly known as pau, pauw, koorhan, knorhaan.

(17) All species of lovebirds (*Agapornis*).

(18) All species of Hoopoes (*Upupidae* and *Irrisoridae*).

(19) Ground Hornbill (*Bucorvus cafer*).

(20) Secretary birds (*Sagittarius serpentarius*).

(21) Lemur (*Gelago crassicaudatus*).

(22) Aard Wolf.

(23) Nyala.

(24) White rhinoceros.

(25) Pangolin.

(26) Elephant (in respect of specimens of which tusks do not exceed 11 lbs. in weight each).

(27) Eland is protected in a portion of the Melsetter District until August, 1942.

LICENCES.

The following are the fees for game licences:—

(*a*) Ordinary game licence	£1	0	0
(*b*) For a special game licence to a person domiciled in Southern Rhodesia	5	0	0
(*b*) To a person not so domiciled	25	0	0
(*c*) For a royal game licence to a person domiciled in Southern Rhodesia......	25	0	0
(*c*) To a person not so domiciled	50	0	0
(*d*) For an owner's game licence	1	0	0
(*e*) For a sale licence	10	0	0

An unlimited number of game of Class A may be hunted under an ordinary licence.

The holder of a special game licence may hunt three head of each of the species mentioned in Class B and no more, or should he elect to hunt more than three head of any one species in that class, then not more than fifteen head of game mentioned in Class B in all.

The number of head of royal game which may be hunted under a royal game licence is specified on each licence.

An owner's game licence entitles the holder to hunt any game animals (whether open season or close season and whether day or night) other than game protected by Proclamation. It does not entitle the holder to hunt any game birds except ostriches.

A sale licence entitles the holder to sell any dead game lawfully taken in the Colony during the open season, but does not authorise the sale of biltong or the hides or skins of game, for which a special permit is necessary.

With the exception of a royal game licence, licences are issued by Magistrates, Civil Commissioners and Native Commissioners.

The royal game licence is issued at the discretion of the Minister of Agriculture and Lands.

The shooting of game at night is prohibited, except where permission is granted by the Act.

The owner or occupier of cultivated land may shoot any wild animal or bird actually doing damage on such land.

Licences are not transferable and must be produced upon demand by any police officer.

The holder of a licence must not hunt game or trespass upon the land of another without permission of the owner or occupier.

Animals may not be hunted in the Wankie, Kazuma Pan, Victoria Falls, Lake Alice and Gona-re-zhou Game Reserves or the Matopos National Park.

The use of motor vehicles or aircraft for the purpose of hunting or stampeding animals and the driving or surrounding of animals by means of fire are prohibited.

The possession of any wire snare or any other device for the snaring and trapping of animals is an offence on private land without the permission of the owner.

Certain animals and birds, the protection of which is necessary or desirable in the continent of Africa, are known as "prescribed animals," and a "trophy" of any prescribed animal is any durable portion of or anything part of or produced from such animal, unless it shall have lost its original identity by a process of *bona fide* manufacture.

Of prescribed animals those which are found in this Colony are:—

> Lemurs, aard wolf, nyola, white and black rhinoceros, elephant, giraffe, pangolin, marabou, ground hornbill, ostrich, secretary bird, egrets and buff-backed heron.

Import into or export from the Colony of any prescribed animal or trophy may not take place, except at places where there is a customs port of entry.

The export of any prescribed animal or trophy without a certificate from the Minister is prohibited.

Trophies of ivory or rhinoceros horn for export must be identified by marks prescribed by the Minister. Other trophies must be so described in the certificate of export as to be identified with as much certainty as possible.

The selling or manufacturing from or otherwise dealing in any prescribed animal or trophy is prohibited, unless such shall have been lawfully imported into or obtained in the Colony.

Prescribed animals, alive or dead, and their trophies, if taken unlawfully or found, belong to the Governor.

Persons finding dead prescribed animals or trophies or killing such animals in defence of self or another or in error or by accident, unless equipped with a permit or licence, must report the fact at once to the nearest Government official and shall deliver to such official such of the trophies as may be required by the Governor. Payment may be made to cover the cost of transport of trophies to the nearest Government station in cases as the Governor may deem fit.

It is unlawful for a person to possess, receive or traffic in any prescribed animal or trophy which is the property of the Governor with the intent of depriving the Governor of the same.

No live game or hippopotamus tusks may be exported from the Colony without the written permission of the Minister of Agriculture and Lands. Exporters of live game must also obtain a certificate of health from the Chief Veterinary Surgeon, Salisbury.

The issue of permits for the capture or hunting of game for scientific or other purposes is at the discretion of the Minister of Agriculture and Lands, to whom application should be addressed by the scientific institute or zoological society requiring the specimens.

The hunting of game without licence is permitted in certain specified tsetse fly areas in the Wankie and Melsetter districts.

Heavy penalties are provided for contravention of the Act.

(Summarised from the "Game and Fish Preservation Act, 1929," as amended, and from relative Government Notices and Proclamations.)

Bugs and beetles take their toll
but
Cleanliness Aids Insect Control.

Rhodesia Weather Bureau.

MARCH, 1939.

Pressure.—The mean barometric pressure was considerably below normal over the whole country. The lowest mean was at Umtali, 2.0 mb. below.

Temperature.—Mean monthly maxima were very low, varying from Fort Victoria 6.5° F. below normal to Stapleford 2.8° F. below. Mean minima were generally about normal, so that the mean temperature for the country was 2—3° F. below normal. Humidity as measured by dewpoint was about normal.

Rainfall.—The heavy continuous rains experienced in February continued into the early part of March and were succeeded by fairly general shower conditions, which continued to the 17th. From that date widespread precipitation ceased, although showers were recorded every day to the end of the month. The average for March was 6.8 inches, or 2.4 inches above normal. The total from the 1st October is 39.6 inches, a figure which has been exceeded twice—1917/18 with 45.1 and 1924/25 with 45.2 inches.

The weather generally was overcast early in the month and a fair amount of cloud continued through the month.

Station.	Inches.	Normal.	No. of Days.
Beitbridge	0.64	1.58	8
Bindura	9.94	4.95	16
Bulawayo	6.12	3.31	11
Chipinga	15.07	7.91	23
Enkeldoorn	3.78	4.03	15
Fort Victoria	5.25	3.52	17
Gwaai Siding	10.04	3.39	15
Gwanda	1.25	3.00	8
Gwelo	5.37	3.39	14

Station.	Inches.	Normal.	No. of Days.
Hartley	6.24	4.35	16
Inyanga	12.51	5.44	18
Marandellas	9.30	5.89	15
Miami	11.79	4.77	23
Mount Darwin	5.39	3.65	15
Mount Nuza	24.93	9.80	26
Mtoko	5.92	3.54	17
New Year's Gift	8.55	3.74	22
Nuanetsi	3.61	2.45	16
Plumtree	3.90	2.82	10
Que Que	7.68	3.89	15
Rusapi	15.14	5.06	18
Salisbury	11.82	4.47	20
Shabani	4.62	4.05	14
Sinoia	10.83	4.11	18
Sipolilo	13.12	4.04	19
Stapleford	23.93	11.23	25
Umtali	13.64	5.23	23
Victoria Falls	4.39	3.84	18
Wankie	4.29	3.01	17
Abercorn	8.56	—	18
Balovale	6.35	—	12
Broken Hill	5.50	—	16
Fort Jameson	6.51	—	19
Fort Roseberry	2.70	—	9
Isoka	13.38	—	21
Kanchindu	13.40	—	18
Kapiri Mposhi	5.85	—	14
Kasama	9.95	—	17
Kasempa	3.39	—	10
Livingstone	5.33	—	17

Station.	Inches.	Normal.	No. of Days.
Lusaka	8.36	—	19
Mankoya	10.54	—	12
Mazabuka	7.41	—	16
Mkushi	8.75	—	17
Mongu	13.42	—	16
Mpika	4.33	—	17
Mporokoso	7.61	—	20
Mufulira	9.39	—	20
Mwinilunga	5.53	—	16
Namwala	7.97	—	13
Ndola	5.16	—	15
Senanga	6.96	—	17
Sesheke	5.82	—	12
Shiwa Ngandu	4.99	—	19
Solwezi	6.01	—	14

MARCH, 1939

Station	Altitude (Feet)	Temperature in Stevenson Screen at 4 feet °F — 8-30 a.m. Dry Bulb	8-30 a.m. Wet Bulb	8-30 a.m. Dew Point	8-30 a.m. Vapour Press Deficit	Maximum	Minimum	Max + Min ÷ 2	Absolute Maximum	Date	Absolute Minimum	Date	Number of Days Max > 85°	Max < 70°	Min > 65°	Min < 40°	Mean of 24 hours	Pressure Millibars 8-30 a.m. Station Level	8-30 a.m. 1200 gdm	Mean of 24 hours	Cloud Tenths	Sunshine Hours
Beitbridge...	1,486	72.6	67.1	64	7.0	84.4	65.5	74.9	92	24	58	29	15	.	17	.	73.6	963.0	881.1	961.5	6.2	...
Bindura...	3,700	67.3	64.0	62	3.9	76.9	62.5	69.7	82	12	57	29		...	2	...	68.6	..	...	..	7.9	...
Bulawayo	4,393	63.1	60.3	58	3.0	73.6	58.1	65.8	80	1	49	23		4	..	...	65.6	868.1	879.6	866.8	7.8	6.2
Chipinga	3,685	64.3	63.1	62	1.3	72.1	60.5	66.3	77	10	54	30		6	2	...	65.1	890.8	880.2	..	7.7	..
Enkeldoorn	4,808	62.3	60.0	59	2.5	72.1	57.9	65.0	79	24	51	29	...	7	...	...	63.3	855.5	879.3	..	8.1	..
Fort Victoria... ...	3,571	64.2	62.2	61	2.2	73.7	59.9	66.8	81	14	54	25		6		..	65.4	894.5	880.2	893.6	6.9	.
Gwaai Siding... ...	3,278	67.8	63.9	62	4.5	81.8	62.0	71.9	89	25	51	24	7	.	11	...	..	902.5	879.2	..	5.5	...
Gwanda...	3,233	66.7	63.5	62	3.7	75.7	61.2	68.5	82	24	55	24		2	3	...	67.2	905.1	880.1	..	7.7	.
Gwelo	4,629	63.4	60.4	58	3.3	73.1	58.3	65.7	80	12	51	25	..	6		...	64.1	860.6	879.3		6.9	...
Hartley...	3,879	66.5	62.7	61	4.4	76.6	59.8	68.2	83	13	51	23		3	1	.	67.0	883.4	878.9	...	6.0	...
Inyanga...	5,503	63.9	60.3	58	3.9	70.3	55.8	63.1	77	10	48	25	...	12	...	..	61.6	..		...	6.7	...
Marandellas	5,453	60.8	58.7	57	2.2	69.9	56.2	63.1	76	10	48	30	...	14		...	61.4		.	..	8.3	...
Miami	4,090	65.4	63.3	62	2.4	74.8	61.2	68.0	81	25	56	25		4	...	...	65.8	876.4	878.4	875.1	8.1	..
Mt. Darwin	3,179	69.3	65.5	63	4.7	77.1	64.4	70.7	84	25	59	29	..	1	12	...	69.5	...	...	...	8.3	...
Mount Nuza	6,668	55.0	54.8	55	0.3	59.8	51.5	55.6	66	10	45	28	...	31	.	...	...	799.3	879.5	...	9.1	...
Mtoko	4,136	66.1	62.8	61	3.8	71.9	60.2	66.0	77	11	52	30	...	7	...	...	64.5	875.4	879.0	874.2	7.0	..
New Year's Gift...	2,690	68.8	66.0	65	3.4	77.3	62.9	70.1	83	10	55	29	..	1	9	..	...	...	...	...	..	4.3
Nuanetsi	1,547	70.7	68.1	67	3.2	80.7	64.3	72.5	86	24	57	24	1	2	13	...	...	961.3	881.1	...	7.5	...

MARCH, 1939 (continued)

Station	Altitude (Feet)	Temperature in Stevenson Screen at 4 feet °F: 8-30 a.m.: Dry Bulb.	8-30 a.m.: Wet Bulb.	8-30 a.m.: Dew Point	8-30 a.m.: Vapour Press Deficit	Maximum	Minimum	Max. + Mim. ÷ 2	Absolute: Maximum	Date	Absolute: Minimum	Date	Number of Days: Max > 85°	Max. < 70°	Min > 65°	Min. < 40°	Mean of 24 hours	Pressure Millibars: 8-30 a.m. Station Level	8-30 a.m. 1200 gdm.	Mean of 24 hours	Cloud Tenths	Sunshine Hours
Plumtree	4,549	64.2	60.3	58	4.2	74.3	58.4	66.3	81	10	54	19	...	4		...	65.0	...	...	...	5.2	...
Que Que	3,999	65.7	61.9	60	4.2	76.9	59.5	68.2	84	12	51	23	...	2	..	...	66.5	880.1	879.3	878.3	6.7	...
Rusape	4,648	62.9	60.8	60	2.3	70.9	58.7	64.8	78	12	48	29	..	10	..	...	53.7			...	8.1	...
Salisbury	4,831	64.0	60.4	58	4.1	73.9	57.4	65.6	80	25	50	23	...	6		...	64.1	854.3	879.1	853.0	7.9	5.0
Shabani	3,131	67.1	63.6	62	4.2	75.4	62.5	68.9	82	1	54	29	.	2	5	..	67.7	..	...	..	8.7	...
Sinoia	3,795	67.6	64.5	63	3.7	77.5	61.4	69.5	83	24	54	26		2	4	..	67.8		..	...	7.4	.
Sipolilo	3,876	67.1	63.9	62	3.9	75.2	61.4	68.3	80	25	55	30	..	4	1	...	.	...	...	..	...	..
Stapleford	5,304	59.8	58.6	58	1.3	66.7	54.7	60.7	73	10	43	23		21	..	...	60.0	..	...	...	8.5	...
Umtali	3,672	65.6	63.5	63	2.4	74.8	61.2	68.0	82	10	55	23	...	4	5	...	66.9	890.7	879.7	889.5	7.5	...
Victoria Falls... ...	3,009	70.3	66.7	65	4.5	82.2	64.0	73.1	90	25	54	24	7		16	...	70.9	..	...	..	6.2	...
Wankie...	2,569	71.0	67.5	66	4.5	84.5	65.6	75.0	92	25	53	24	16		16	...	73.4	924.6	878.8	...	5.7	...
Abercorn	5,458	64.5	61.1	59	3.7	75.8	59.1	67.4	80	3	57	1	...		...	...	...	836.5	879.8	...	5.9	...
Broken Hill	3,911	65.8	63.8	63	2.3	76.7	61.8	69.3	84	9	55	30	...	.	...	..	...	882.1	878.3	...	7.7	.
Chipili	3,900	68.2	65.4	64	3.4	80.9	64.3	72.6	86	4	60	30	1		8	..	...	...	...	...	..	...
Fort Jameson ...	3,815	67.5	63.9	62	4.2	77.6	63.5	70.6	82	24	58	30	...	.	3	..	...	885.7	879.2	...	6.3	...
Kasama...	4,562	66.1	63.5	62	3.0	77.8	62.2	70.0	82	9	60	29	...	1	...	..	..	...	...	...	...	...
Kasempa	4,500	65.5	63.3	62	2.5	78.2	59.0	68.6	84	10	54	23	..	.	...	..	...	..		..	...	...
Livingstone	3,051	67.3	65.3	64	2.4	81.5	62.6	72.1	87	25	53	24	6	1	16	...	70.6	908.9	878.2	907.5	6.9	...
Lusaka	4,193	65.9	63.4	62	2.8	74.4	61.2	67.8	83	10	57	29	.	2	...	.	...	872.9	878.2	...	7.9	3.9
Mazabuka	3,385	68.2	65.8	65	2.8	78.3	63.2	70.7	86	10	58	29	1	..	7	...	...	..	.	...	...	5.3
Mongu	3,481	69.3	66.4	65	3.6	82.1	64.7	73.4	89	10	59	27	6	..	11	..	..	894.2	877.2	...	7.0	...
Mpika	4,620	64.6	62.6	62	2.2	77.0	60.6	68.8	83	5	57	29	..	1	..	..	...	861.2	879.5	...	9.0	...
Mwinilunga	4,450	66.6	64.2	63	2.8	79.5	60.1	69.8	82	9	58	18	...	..	..	..	...	...	..	..	...	...
Ndola	4,190	65.7	63.4	62	2.6	78.2	61.2	69.7	85	11	56	30	...	...	...	...	...	873.6	878.7	...	7.2	...

Rainfall in March, 1939, in Hundredths of an Inch. Telegraphic Reports.

Area	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	Total	Normal
1	5	25	2	..	...	24	4	33	...	45	92	37	13	14	32	38	17			1	2	1	1	.	..	1	1	.	...	...	...	388	322
2	34	97	25	11	21	286	15	.	.	1	27	52	15	11	44	80	27	12	9	12	3	1	1	...	..	9		.	.	...	3	799	606
3	143	305	121	25	21	291	14	.	..	59	63	144	3	7	58	55	33	3	38	22	7	1	...	1	35	41	25	1	...	21	4	1541	803
4	7	32	15	6	4	121	27	78	1	..	5	31	82	31	83	76	10	4	...	6	6	..	...	..	..	2	...	...	...	1	..	628	503
5	4	12	10	6	4	16	22	39	48	69	24	33	2	23	9	60	13	4		...	..	...	...	.	...	.	14	1	6	...	...	419	297
6	27	18	2	2	65	67	96	43	15	48	.	30	99	56	170	8	15	..		.	...	.	..		..	...	23	..	...	...	...	784	471
7	30	156	101	71	149	107	108	66	22	6	25	38	61	23	52	25	21	7	1	2	7	...	...		...	10	3	...	.	...	2	1093	592
8	20	57	69	19	208	114	99	70	40	22	...	47	48	8	226	24	13	4			14	6	.	...	2	1	9	1	..	..	4	1125	519
9	86	47	50	39	53	114	62	31	6	11	34	19	3	5	130	14	19	17	..	5	43	19	...	...	1	6	8	5	..	...	...	827	451
10	3	10	75	43	93	45	114	15	65	...	...	17	2	..	18	14	10	..	4	18	19	..	...	..	...	...	...	...	...	...	...	565	364
Mean	26	51	30	18	44	96	48	37	18	29	32	35	31	20	70	41	17	6	2	4	9	3	1	...	1	4	7	1	1	...	1	683	443

SOUTHERN RHODESIA

Locust Invasion, 1923-39.

Monthly Report No. 76. March, 1939.

During the present season, up to the end of March, hoppers of the Red Locust (*Nomadacris septemfasciata*, Serv.) have appeared in twenty-two out of the thirty-two districts of the Colony, namely, Sebungwe, Lomagundi, Darwin, Mtoko, Mrewa, Mazoe, Salisbury, Makoni, Inyanga, Umtali, Melsetter, Bikita, Charter, Victoria, Ndanga, Chibi, Belingwe, Gwanda, Matobo, Balalima-Mangwe, Insiza and Gwelo.

In many of the districts only small hatchings have occurred, but the hatchings have been considerable in Darwin, Mrewa, Mtoko, Umtali, Bikita, Belingwe and Ndanga.

Country in native occupation has been mainly affected and efforts have been concentrated on protecting the crops. The continuous rains and swollen rivers have hampered operations, but no widespread damage has as yet been reported.

Towards the end of March hoppers were reported to have died from natural causes in two districts, but the cause of death has not yet been ascertained.

A small supply of the locust bait used in the Union of South Africa was obtained during February for experimental purposes. This has been distributed to various districts with instructions in the method of use, and a request for a report on the results obtained. One farmer has reported very satisfactory results. Unfortunately, the overwhelming rains and the remoteness of the outbreaks have prevented any officer of this branch from carrying out experiments with the bait.

RUPERT W. JACK,
Chief Entomologist.

Southern Rhodesia Veterinary Report.

MARCH, 1939.

DISEASES.

No fresh outbreaks of scheduled diseases.

TUBERCULIN TEST.

Fifty bulls were tested upon importation and five re-actors were destroyed. One hundred and one head, to be exported to the Belgian Congo, were tested at Bulawayo and there were seven re-actors.

MALLEIN TEST.

Nil.

IMPORTATIONS.

From the United Kingdom.—Bulls 9.

From the Union of South Africa.—Bulls 49, sheep 1,343. pigs 1.

From the Bechuanaland Protectorate.—Sheep 783.

EXPORTATIONS.

To the Union of South Africa.—Oxen 43.

To the Belgian Congo.—Bulls 49, cows 54.

To Portuguese East Africa.—Cows 12, oxen 20, goats 40.

To the Bechuanaland Protectorate.—Goats 13.

EXPORTATIONS—MISCELLANEOUS.

To the United Kingdom.—Chilled beef quarters, 3,945; frozen boneless beef quarters, 594; brains, 56 lbs.; pancreas,

86 lbs.; tongues, 6,384 lbs.; livers, 17,554 lbs.; hearts, 4,499 lbs.; tails, 2,627 lbs.; skirts, 2,756 lbs.

To Northern Rhodesia.—Nil.

To the Belgian Congo.—Beef carcases, 125; offal, 573 lbs.

To the Union of South Africa.—Corned beef, 68,762 lbs.

To Bechuanaland Protectorate.—Corned beef, 10,080 lbs.

To Basutoland.—Corned beef, 360 lbs.

S. A. Myhill,
Chief Veterinary Surgeon.

Departmental Bulletins.

The following Bulletins are available for distribution at 3d. per copy. Application should be made to the Editor, Department of Agriculture, Salisbury, and remittances must accompany orders.

N.B.—The date the article appeared in the Journal is indicated in abbreviated form before the number, e.g., 8/22, No. 429, means that Bulletin 429 appeared in the Journal for August, 1922.

AGRICULTURE AND CROPS.

7/25. No. 545. Artificial or Synthetic Farmyard Manure, by H. G. Mundy, Dip.Agric., F.L.S.

5/27. No. 643. Noxious Weeds in Southern Rhodesia, by F. Eyles, Botanist.

12/27. No. 663. The Use of Fertilisers and Manures in Southern Rhodesia, by A. D. Husband, A.I.C., Chief Chemist.

2/28. No. 674. Top Dressing of Maize against Stalk Borer, by H. C. Arnold.

3/28. No. 681. The Sunflower (Helianthus Annuus) (Revised), by S. D. Timson, M.C., Dip.Agric.

6/28. No. 695. The Castor Oil Plant (Ricinus spp.), by S. D. Timson, M.C., Dip.Agric.

9/28. No. 705. Suggested Cropping Programmes for Farms on the Sand Veld, by D. E. McLoughlin, Assistant Agriculturist.

10/28. No. 710. Monthly Reminders for the Farming Year, by the Division of the Chief Agriculturist.

3/29. No. 727. Farmyard Manure, by A. P. Taylor, M.A., B.Sc., Agricultural Chemist.

5/29. No. 732. Two Common Diseases of Potato Tubers in Rhodesia, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A.

7/29. No. 743. Sunn Hemp, by S. D. Timson, M.C., Dip.Agric.

9/29. No. 751. The Sweet Potato, by S. D. Timson, M.C., Dip.Agric. (Wye).

10/29. No. 758. Instructions for Taking Soil Samples. Issued by the Division of Chemistry.

1/30. No. 768. The Ground Nut (Arachis hypogaea), by S. D. Timson, M.C., Dip.Agric. (Wye).

3/30. No. 776. Regulations Governing the Export of Maize and Maize Meal through the Port of Beira.

11/30. No. 797. Green Manuring: An Essential Practice in Rhodesian Farming, by H. G. Mundy, Dip.Agric. (Wye), F.L.S., Chief Agriculturist.

1/31. No. 802. Witch Weed, by S. D. Timson, M.C., Inter.B.Sc. (Agric.) London., Dip.Agric (Wye), Assistant Agriculturist.

3/31. No. 815. New Strains of Oats for Southern Rhodesia, by H. C. Arnold, Manager, Agricultural Experiment Station, Salisbury.

4/31. No 816. Preliminary List of the more Common Grasses of Southern Rhodesia, by Sydney M. Stent, Botanist for Pasture Research.

5/31. No. 822. Re-stacking of Maize rejected for Export on account of Excessive Moisture.

9/31. No. 826. Some Poisonous Plants of Southern Rhodesia, by Sydney M. Stent, Senior Botanist.

10/31. No. 831. Revised Notes on Cotton Growing in Southern Rhodesia, by G. S. Cameron.

11/31. No. 836. The Potato, by S. D. Timson, M.C., Dip.Agric. (Wye).

12/31. No. 837. Veld Grass Silage: A Feature in Rhodesian Pasture Management, by H. G. Mundy, Dip.Agric. (Wye), F.L.S., Chief, Division of Plant Industry.

6/32. No. 855. Pigeon-hole Method of Stacking Maize, by Division of Plant Industry.

8/32. No. 859. Twenty-one Years of Plant Introduction, by Major Mundy, Chief Division of Plant Industry.

2/33. No 878. A.I.V. Silage: Memorandum prepared and circulated by Imperial Bureau of Animal Nutrition.

11/34. No. 936. Witchweed, by S. D. Timson, M.C. Dip.Agric. (Wye), Assistant Agriculturist.

10/35. No. 970. Rhodes Grass for the Southern Rhodesian Tobacco Grower, by African Explosives and Industries, Ltd.

11/35. No. 972. Notes on Witchweed, by S. D. Timson, M.C., Dip.Agric. (Wye), Assistant Agriculturist.

6/36. No. 992. Annual Report of the Agriculturist for the year 1935, by D. E. McLoughlin, Agriculturist.

4/37. No. 1022. Smut Diseases of Wheat in Southern Rhodesia, by G. M. Wickens, B.Sc. Agric., Ph.D., D.I.C., Plant Pathologist, Tobacco Research Station, Trelawney.

10/37. No. 1046. Green Manuring: Two Important Factors Affecting Success, by S. D. Timson, M.C., Assistant Agriculturist, and H. C. Arnold, Manager, The Agricultural Experiment Station.

10/38. No. 1084. Improved Pastures, by S. D. Timson, M.C., Assistant Agriculturist.

2/39. No. 1101. Grass Silage, by H. C. Arnold, Manager, Salisbury Experiment Station

REPORTS ON CROP EXPERIMENTS.

7/27. No 649. Annual Report of Experiments, 1925-26, Agricultural Experiment Station, Salisbury, by H. C. Arnold, Manager.

4/28. No. 683. Annual Report of Experiments, 1926-27, Agricultural Experiment Station, Salisbury, by H. C. Arnold, Station Manager.

7/29. No. 745. Salisbury Agricultural Experiment Station Annual Report, 1927-28, by H. C. Arnold.

7/30. No. 789. Agricultural Experiment Station, Salisbury. Annual Report of Experiments, 1928-29, by H. C. Arnold.

9/31. No. 830. Salisbury Agricultural Experiment Station, Annual Report, 1929-30, by H. C. Arnold, Manager.

10/32. No. 864. Annual Report, 1930-31: Agricultural Experiment Station, by H. C. Arnold, Station Manager.

6/33. No. 895. Salisbury Agricultural Experiment Station Annual Report, 1931-32, by H. C. Arnold, Manager.
3/34. No. 914. Gwelo Municipal Demonstration Station: Final Report, 1933, by S. D. Timson, M.C., Dip.Agric. (Wye), Assistant Agriculturist.
9/35. No 965 Salisbury Agricultural Experiment Station Annual Report, 1933-34, by H. C. Arnold, Manager.

TOBACCO.

8/26. No. 605. Flue-curing Tobacco Barns, Bulking and Grading Sheds, by P. H. Haviland, B.Sc. (Eng.), Acting Government Irrigation Engineer.
9/26. No. 615. The Culture of Virginia Tobacco in Southern Rhodesia: Field Management, by D. D. Brown.
5/27. No. 641. The Handling, Grading and Baling of Cured Virginia Tobacco, by D. D. Brown.
5/27. No 644. Tobacco Baling Boxes, by B. G. Gundry, Irrigation Branch.
9/27. No. 653 The Care of Tobacco Seed Beds, by J. C. F. Hopkins, B.Sc (Lond.), A.I C.T.A. (Trinidad)
11/27. No 661. Flue-curing Tobacco Barns, 12 ft. x 12 ft. x 16 ft., by B. G. Gundry
1/28. No. 665 Tobacco Pests of Rhodesia, by Rupert W. Jack, F.E.S., Chief Entomologist.
2/28. No. 671. Wildfire and Angular Spot of Tobacco, by J. C. F. Hopkins, B.Sc , A.I C.T.A.
12/28. No. 715 Turkish Tobacco Culture in Southern Rhodesia, by D D. Brown, Chief Tobacco Expert.
3/29. No. 728. Suggested Crop Rotations for Tobacco Growers, by D. D. Brown, Chief Tobacco Expert.
4/29 No. 734 Common Faults in Curing Virginia Bright Tobacco, by D. D. Brown, Tobacco and Cotton Expert.
8/29. No. 748. Frog Eye Disease of Tobacco, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A., Chief Botanist and Mycologist.
9/29. No. 753. Leaf Spotting of Tobacco caused by Mosaic, by J. C. F. Hopkins, B.Sc (Lond.), A.I.C.T.A., Chief Botanist and Mycologist.
2/30. No. 771. Dark Fire-cured Tobacco: Field Operations, by D. D. Brown, Chief Tobacco Expert.
3/30. No 774. Dark Fire-cured Tobacco: Harvesting and Curing, by D. D. Brown, Chief Tobacco Expert.
6/30. No. 784. Field Control of Frenching in Tobacco, by J. C. F. Hopkins, B.Sc. (Lond), A.I.C.T.A., Plant Pathologist.
3/31. No. 812. Selection of Tobacco Seed Plants, by H. F. Ellis, M.Sc., B.S. (Agric.), Tobacco Adviser.
11/31. No. 835. Tobacco Culture: Transplanting Operations, by D. D. Brown.
3/32. No. 846. Leaf Curl in Tobacco, by Dr. H. H. Storey.
3/33. No. 885. Tobacco Culture in Southern Rhodesia: The Harvesting and Curing of Virginia Tobacco, by D. D. Brown, Chief Tobacco Officer.
8/36. No. 996. The "Gundry" Tobacco Furnace, by B. G. Gundry, A.I.Mech.E.

12/36. No. 1009. Tobacco Research on the Trelawney Station 1935-36 Season.

4/37. No. 1025. Report of the Tobacco Research Board, by Chas. K. Brain, M.A., D.Sc., Director of Agriculture and Chairman of the Tobacco Research Board.

5/37. No. 1026. Notes on Tobacco Root-Knot Nematode, by J. C. Collins, B.Sc., Biologist, Trelawney Tobacco Research Station.

8/37. No. 1039. Some Tobacco Pests that can be serious, by M. C. Mossop, M.Sc., Entomologist, Department of Agriculture.

1/38. No. 1054. Alkalinity of Tobacco Seed-bed Soils, by A. P. Taylor, M.A., B.Sc., Agricultural Chemist.

3/38. No. 1063. A New and Serious Disease of Tobacco in Southern Rhodesia, by G. M. Wickens, Ph.D., D.I.C., Plant Pathologist, Tobacco Research Station, Trelawney.

5/38. No. 1070. A Witchweed on Tobacco Roots (*Striga orobanchoides*, Benth.), by Chas. K. Brain, M.A., D.Sc., Director of Agriculture.

6/38. No. 1072. Report of the Tobacco Research Board for the year ending 31st December, 1937, by Chas. K. Brain, M.A., D.Sc., Director of Agriculture, and Chairman of the Tobacco Research Board.

LIVE STOCK

1/27. No. 624. The Construction of Dipping Tanks for Cattle (Revised).

1/31. No. 801. Sheep Farming in the Melsetter District, by J. C. Kruger, Part-time Sheep Adviser in the Melsetter District.

10/32. No. 863. Piggeries, by B. G. Gundry, A.I.Mech.E.

12/32. No. 871. Some General Observations on the Feeding of Dairy Cows on a Mixed Stock Farm, by Dr. A. E. Romyn, Senior Animal Husbandry Officer.

4/33. No. 887. The Type of Chiller Steer required for Export, by A. E. Romyn, Senior Animal Husbandry Officer.

9/33. No. 903. The Handling, Preparation and Chilling of Cattle for Export, by C. A. Murray, Lecturer in Animal Husbandry.

12/33. No. 907. The Blackhead Persian: Its Breeding and Management in Matabeleland, by C. A. Murray, M.Sc., Lecturer in in Animal Husbandry, Matopo Estate.

1/34. No. 909. Stall Fed Chillers for the Overseas Christmas Market, by C. A. Murray, M.Sc., Animal Husbandry Officer, Matopo School of Agriculture and Experiment Station, Rhodes Matopo Estate.

2/34. No. 912. Economical Winter Rations for Wintering Dairy Heifers, by C. A. Murray, M.Sc. (Agric), Lecturer in Animal Husbandry, Matopo School of Agriculture.

4/34. No. 916. Cowpea Hay in the Ration for Bacon Pigs, by C. A. Murray, M.Sc. (Agric.), Lecturer in Animal Husbandry, Matopo School of Agriculture and Experiment Station.

6/34. No. 924. Raising Dairy Calves on a Limited Amount of Whole Milk, by C. A. Murray, M.Sc., Agr., Animal Husbandry Officer, Matopo School of Agriculture and Experiment Station, Rhodes Matopo Estate.

1/35. No. 943. Cattle Improvement and a Cattle Breeding Policy in Southern Rhodesia: A Review of the General Position Chiefly as regards Ranching Cattle, by Dr. A. E. Romyn, Chief Animal Husbandry Officer.

1/35. No. 945 A Home made Cow Stanchion, by Major R. R. Sharp, Whinburn, Redbank.

3/35 No 946 Economical Rations for Wintering Dairy Cattle, by C. A. Murray, M Sc. (Agric.), Senior Animal Husbandry Officer in Charge, Matopo School of Agriculture and Experiment Station.

5/35. No 952 Annual Report of the Chief Animal Husbandry Officer for the year ending 31st December, 1934, by A. E. Romyn, Chief Animal Husbandry Officer.

7/35 No 959. The Selection of a Dairy Bull, by A. E. Romyn, Ph.D., Chief Animal Husbandry Officer.

4/36 No. 984 Report on the Curing of Rhodesian Hides, by Advisory Committee on Hides and Skins of the Imperial Institute.

4/36. No 985. Export of Frozen Porkers. Third Consignment to Smithfield Division of Animal Husbandry.

5/36. No. 987 The Curing of Hides and Skins on the Farm, by The Division of Animal Husbandry.

5/36. No 988 Preparing Cattle for Show, by The Animal Husbandry Division.

6/36. No 989 The Supplementary Feeding of Mineral and Protein Supplements to Growing Cattle in Southern Rhodesia and its Relation to the Production of Beef Steers, by C. A. Murray, M Sc. (Agric.), Senior Animal Husbandry Officer in Charge, Rhodes Matopo Estate; A. E Romyn, Ph D, Chief Animal Husbandry Officer, Department of Agriculture, Southern Rhodesia; D. G Haylett, Ph D, Director, Rhodes Matopo Estate; F. Ericksen, Dip. Agric., Experimentalist

10/36 No 1001. The Raising of Bacon Pigs, by A. E. Romyn, Chief Animal Husbandry Officer, and C. A. Murray, Senior Animal Husbandry Officer in Charge, Rhodes Matopo Estate, with a Veterinary Section by D. A. Lawrence, Director of Veterinary Research.

9/36. No. 1000. Sheep Management on the Mixed Farm, by R H. Fitt, Animal Husbandry Officer.

4/37. No. 1023. Cowpea Molasses Silage for Fattening Steers, by C A. Murray, M.Sc. (Agric.), Senior Animal Husbandry Officer in Charge, Matopo School of Agriculture and Experiment Station; A. E. Romyn, Ph.D., Chief Animal Husbandry Officer, Department of Agriculture, Salisbury; R H. Fitt, Dipl. Agric., Animal Husbandry Officer, Department of Agriculture, Salisbury.

4/37. N. 1024. Comparative Feeding Value of Maize Meal and Nyouti (*Pennisetum Typhoides*) Meal for Fattening Steers, by C. A. Murray, Senior Animal Husbandry Officer in Charge, Rhodes Matopo Estate; A. E. Romyn, Chief Animal Husbandry Officer.

5/37. No. 1027. The Feeding of Phosphorus Supplements to Growing Cattle, by C. A. Murray and A. E. Romyn.

5/37. No. 1029. The Dehorning of Cattle intended for Slaughter and Export, by B. A. Myhill, Assistant Chief Veterinary Surgeon.

5/37. No. 1030. The Feeding of Different Winter Supplements to young growing steers and the effect of these supplements on the subsequent development and costs of production of the steers, by C. A. Murray and A. E. Romyn.

6/37. No. 1032. The Effects of Feed on the Firmness and Grading of Bacon Carcases, an experiment carried out by the Division of Animal Husbandry in co-operation with Mr. A. L. Millar, Estes Park, Salisbury, and Mr. Frank Neill, of Neill's Bacon Factory, Salisbury.

6/37. No. 1034. Nyouti or Munga (*Pennisetum typhoides*) as a Feed for Bacon Pigs, by C. A. Murray and A. E. Romyn.

7/37. No. 1036. Preliminary Report on the Feeding of Winter Supplements to young growing steers and the effect of supplementary feeding on the subsequent development of these animals, by C. A. Murray and A. E. Romyn.

12/37. No. 1049. The Export of Frozen Porkers: Report on Five Consignments of Porkers Exported to Smithfield, by Division of Animal Husbandry.

1/38. No. 1053. The Feeding of Sunnhemp Hay as compared with Cowpea Hay in the Fattening Ration for Bullocks, by A. E. Romyn and R. H. Fitt

2/38. No. 1058. Pig Industry Act, 1937. Division of Animal Husbandry.

9/38. No. 1083. Internal Parasites in Sheep, by Percy D. Huston, M.R.C.V.S., District Veterinary Officer.

11/38. No. 1091. Cost of Fattening Bullocks of various ages in Matabeleland, by A. E. Romyn and C A. Murray.

DAIRYING.

12/30. No. 799. The Objects of Ripening Cream for Butter-making, and a few Hints on Cream Production, by F. Lammas, Dairy Officer.

9/32. No. 862. Cream Cheese, by F. A. Lammas, Dairy Officer.

3/33. No. 880. Dairy Tests and Calculations, by F. A. Lammas, Dairy Officer.

5/34. No. 922. Dairy Building in Southern Rhodesia: A Small Farm Dairy, by G. B. Gundry, A.I.Mech.E.

7/34. No. 926. Dairy Buildings in Southern Rhodesia. Cow Byre—Type II., by B. G. Gundry, A.I.Mech.E.

12/34. No 937. Gouda or Sweet Milk Cheese, by F. Lammas, District Dairy Officer.

2/36. No. 977. Notes on the Feeding of Dairy Cows during the Summer Months, by A. E. Romyn, Chief Animal Husbandry Officer.

6/36. No. 990. Southern Rhodesia Milk Recording Scheme.

12/37. No. 1051. The Production and Handling of Milk and Cream, by the Dairy Branch.

12/38. No. 1094. Farm Butter Making, by The Dairy Branch.

VETERINARY.

10/14.	No.	191.	Scab or Scabies in Sheep and Goats, by Rowland Williams, M R.C V.S.
12/25.	No.	570.	The Spaying of Bovines, by G. C. Hooper Sharpe, M.C., M.R.C.V.S., and M. H. Kingcombe, M.R.C.V.S.
6/26.	No.	597.	Suspected Poisoning of Stock: The Proper Procedure, by M. H. Kingcombe, M.R.C.V.S. (Lond.), and A. W. Facer, B.A. (Oxon.), A.I C.
12/26	No.	618.	Notes from the Veterinary Laboratory: Quarter Evil, by Ll. E. W. Bevan, M.R.C.V.S , Director of Veterinary Research.
1/28.	No.	666	Notes from the Veterinary Laboratory: Praemonitus—Praemunitus, by Ll. E. W. Bevan, M.R.C.V.S., Director of Veterinary Research.
10/29.	No	756.	Parasitic Gastritis of Cattle, by Ll. E. W. Bevan, M.R.C.V.S., Director of Veterinary Research.
11/29.	No.	760	A Note on Sheep Diseases in Southern Rhodesia, by D. A. Lawrence, B.V.Sc., Veterinary Research Officer, Department of Agriculture, Salisbury.
2/30.	No	772	Notes from the Veterinary Laboratory: Ophthalmia, by Ll. E. W Bevan, M.R.C.V.S., Director of Veterinary Research.
4/31.	No	819	Measles in Swine, by P D. Huston, M.R.C.V.S.
1/32.	No	841.	Poisonous or Suspected Poisonous Plants of Southern Rhodesia: Tulip Poisoning of Cattle, by Sydney M. Stent, Senior Botanist, and D A. Lawrence, B V Sc , Veterinary Research Officer.
10/32.	No	866	The Treatment of Intestinal Parasites of Sheep, by J. D. Coutts, D.V.S , M.R C V S.
4/33.	No.	886	A Preliminary Note on Contagious Granular Vaginitis in Southern Rhodesia, by D. A. Lawrence, B V.Sc., Acting Director Veterinary Research

IRRIGATION, WATER SUPPLIES AND SOIL EROSION.

4/27.	No.	640.	Levelling for Irrigation, by Dr. W. S. H. Cleghorn, M.I Mech E.
11/27.	No	659	The Hydraulic Ram, revised by P. H Haviland, B.Sc.
11/28	No.	668	The Water Act, 1927, by C. L. Robertson, B.Sc. (Eng), A.M.I.C E.
1/28.	No	670.	Irrigation Canals, by P. H Haviland, B Sc. (Eng.).
6/30.	No.	786.	Low Concrete Dams, by R Hamilton Roberts, B Sc. (Eng.), Assistant Irrigation Engineer.
2/31.	No.	808.	The Application of Water in Irrigation, by R. Hamilton Roberts, B.Sc. (Eng.), Assistant Irrigation Engineer.
3/31.	No	811.	Irrigation Canal Structures, by R. H. Roberts, B.Sc. (Eng.), Assistant Irrigation Engineer.
8/32.	No.	860.	Soil Drainage and Utilisation of Vleis, by R. H. Roberts, B.Sc. (Eng.), Assistant Irrigation Engineer.
2/33.	No	879.	Conditions Governing the Hire of Government Boring Machines.
6/35.	No	956.	Annual Report of the Division of Irrigation for the year ended 31st December, 1934, by P. H. Haviland, B.Sc. (Eng.), Acting Chief Irrigation Engineer.

9/35. No. 964. The Use of Ditchers for Constructing Contour Ridges, by C. Tapson, Devondale, Concession.

9/35. No. 967. How to use an Engineer's or Farm Level, by P. H. Haviland, B.Sc. (Eng.), A.M.I.C.E., Irrigation Engineer (Matabeleland).

12/35. No 973. Domestic Water Supplies and Sanitation on the Farm, by P. H. Haviland, B.Sc. (Eng.), A.M.I.C.E.. Irrigation Engineer (Matabeleland).

3/36. No. 980 Results from Glenara Soil Conservation Experiment Station, 1934-35 Season, by C. L. Robertson, B.Sc. A.M I.C.E., Chief Engineer, Irrigation Division, and A. D. Husband, F.I.C., Chief Chemist.

8/36. No. 999. Lining an Irrigation Furrow, by R. H. Roberts, B.S., A.M.Inst.C.E., Assistant Irrigation Engineer.

1/38. No. 1052 Small Earthen Storage Dams. Part I. By the Irrigation Division.

2/38. No. 1055. Small Earthen Storage Dams. Part II. By the Irrigation Division.

3/38. No. 1061. Soil Drainage and Utilisation of Vleis, by R. H. Roberts, B.Sc. (Eng), Assistant Irrigation Engineer.

7/38. No. 1077. A Small Brick Irrigation Furrow, by H. W. H Wallis, Assistant Irrigation Engineer.

1/39. No. 1095. Soil and Water Conservation, by D. Aylen, for the Irrigation Division.

4/39. No. 1108. Three Important Strawberry Diseases, by J. C F. Hopkins, D.Sc. (Lond.), A I.C.T.A., Senior Plant Pathologist.

FORESTRY.

11/29. No 763. The Utilisation of Wood, by T. L. Wilkinson, M.Sc., B Sc F.

1/30. No. 769. The Utilisation of Wood, by T L. Wilkinson, M.Sc , B.Sc F

4/30. No. 778. The Utilisation of Wood in Southern Rhodesia—Conversion and Disposal of Timber, by T. L. Wilkinson, M Sc , B.Sc F., District Forest Officer

8/30. No. 791. The Utilisation of Wood in Southern Rhodesia: Fencing, by T. L. Wilkinson, M.Sc., B.Sc.F., District Forest Officer.

2/31. No. 809. Establishing Pines: Preliminary Observations on the Effects of Soil Inoculation. Issued by the Division of Forestry.

7/32. No. 857. Charcoal Burning on the Farm, by R J. Allen, Forester, Rhodes Matopo School of Agriculture and Experiment Station.

11/32. No 869. Wind-breaks and Shelter Belts, by A. A. Pardy, B.Sc , Forestry.

1/33. No. 874. Tree Planting, by the Division of Forestry.

4/33. No. 888. The Vegetable Ivory Palm (Hyphoene ventricosa), by G. M. McGregor, B.Sc., District Forest Officer, Matabeleland.

8/34. No. 927. Some Facts about Tung Oil, by R. H. Finlay, B.A., Dip. For. (Oxon.), District Forest Officer.

8/34. No. 928. Some Trees, Shrubs, Shrubby-Herbaceous Plants, Climbers and Water Plants suitable for the Colony, by J. W. Barnes, Manager, Government Forest Nursery, Salisbury.

12/35.	No 974.	Summary of the Annual Report of the Division of Forestry for the year 1934, by E J. Kelly-Edwards, M.A., Dip. For. (Oxon.), Chief Forest Officer. Price List of Forest-tree Transplants, Ornamental Trees Shrubs, Hedge Plants, Creepers and Seeds obtainable at the Government Forest Nursery, Salisbury.
3/37.	No 1020.	The Raising of Forest Seedlings and Transplants on the Farm, by E. J Kelly Edwards, M.A., Dip. For. (Oxon.), Conservator of Forests.
10/37.	No. 1045	Seventeenth Annual Report of the Division of Forestry for the Year 1936, by E. J. Kelly Edwards, M.A., Dip. For. (Oxon.), Conservator of Forests.
6/38	No. 1073.	Pruning of Plantations, by R. H. Finlay, B.A., Oxon., Division of Forestry.
7/38.	No. 1076	Eighteenth Annual Report of the Division of Forestry for the year 1937, by E. J. Kelly Edwards, M.A., Dip. For. (Oxon.), Conservator of Forests.
10/38.	No. 1085.	The Pot Planting of Eucalypts, by Major G. R. Wake, Vigila, Umvukwes.
11/38	No. 1087	The Raising and Planting of Trees on the Farm, by E J Kelly Edwards, M.A., Dip. For (Oxon), Conservator of Forests

HORTICULTURE

4/27	No 637	Harvesting, Packing and Marketing of Deciduous and Tropical Fruits, by G W. Marshall, Horticulturist.
8/27	No 650.	Coffee Culture in Southern Rhodesia, by G W. Marshall, Horticulturist.
2/29	No 725	Investigations into "Collar-Rot" Disease of Citrus, by J C F. Hopkins, B Sc (Lond), A I C T.A. (Trinidad)
11/31.	No 834	Celery Culture, by G. W. Marshall, Horticulturist.
2/33.	No. 876.	Notes on African Aloes (Parts 1-6), by H. Basil Christian, "Ewanrigg," Arcturus.
10/33	No 905.	Notes on African Aloes (Parts 7-10), by H. Basil Christian, "Ewanrigg," Arcturus.
5/34	No. 920	Citrus Fruit Growing in Rhodesia, by G W. Marshall, Horticulturist.
5/37.	No. 1028.	Tomato Culture in Southern Rhodesia, by G. W. Marshall, Horticulturist.
9/37.	No. 1043.	The Rhodesian Home Orchard, by G W. Marshall, Horticulturist.
2/39	No 1100.	The Rhodesian Home Orchard, by G W. Marshall, Horticulturist.

ENTOMOLOGY AND PLANT PATHOLOGY.

2/13	No 139.	Termites, or "White Ants," by Rupert W. Jack, F.E.S
6/15.	No. 214.	Some Household Insects, by R. Lowe Thompson, B.A.
2/21	No 385.	The Common Fruit Beetle, by R. W. Jack, F.E.S.
12/24	No. 522	Notes on the Black Citrus Aphis, by C. B. Symes.
8/25.	No. 548.	Insect Pests of Cotton, by C. B. Symes.
9/27	No. 653	The Care of Tobacco Seed Beds, by J. C. F. Hopkins, B.Sc. (Lond.), A I.C.T.A. (Trinidad).
1/28	No 665.	Tobacco Pests of Rhodesia, by Rupert W. Jack, F.E.S., Chief Entomologist.
2/28.	No. 671.	Wildfire and Angular Spot of Tobacco, by J. C. F. Hopkins, B.Sc., A.I.C.T.A.

6/28. No 696. Ticks Infesting Domestic Animals in Southern Rhodesia, by Rupert W. Jack, F.E.S., Chief Entomologist.

11/28. No. 714. Trap Cropping against Maize Pests, by Rupert W. Jack, F.E.S., Chief Entomologist.

12/28. No. 718. Preliminary Experiments on the Control of White Mould of Tobacco, by J. C. F. Hopkins, B.S. (Lond.), A.I.C.T.A., Chief Botanist and Mycologist.

3/29. No. 732. Two Common Diseases of Potato Tubers in Rhodesia, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A.

6/29 No. 742. What is Diplodia in Maize? An Answer to a Popular Question To-day, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A., Chief Botanist and Mycologist.

8/29. No. 748. Frog Eye Disease of Tobacco, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A., Chief Botanist and Mycologist.

9/29. No. 753. Leaf Spotting of Tobacco caused by Mosaic, by J. C. F. Hopkins, B Sc (Lond.), A.I.C.T.A., Chief Botanist and Mycologist.

9/29. No. 754. "Pinking" of Maize: Report of a Preliminary Investigation, by T. K. Sansom, B Sc , Plant Breeder.

6/30. No. 784. Field Control of Frenching in Tobacco, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A., Plant Pathologist

6/30. No. 788. A List of Plant Diseases Occurring in Southern Rhodesia, by J. C. F. Hopkins, B Sc. (Lond), A.I.C.T A., Plant Pathologist.

A List of Plant Diseases Occurring in Southern Rhodesia, by J. C. F. Hopkins, B.Sc. (Lond), A.I.C.T.A., Plant Pathologist. Supplement No. 1

7/30. No 790. Notes on the Control of Some of the More Important Insect Pests of Citrus in Southern Rhodesia, by W. J. Hall, Ph D., B.Sc , Entomologist to the British South Africa Company in Southern Rhodesia.

10/30. No. 796. The Army Worm (Laphygma exempta, Wlk.), by Rupert W. Jack, Chief Entomologist.

11/30. No 798 The Preparation of Bordeaux Mixture and Seasonal Notes on Tobacco Diseases, by J. C. F. Hopkins, B.Sc. (Lond.), A I C T.A.

1/31. No. 804. Locusts in Southern Rhodesia, by Rupert W. Jack, Chief Entomologist.

8/31. No. 825. Some Common Diseases of Potatoes in Southern Rhodesia, by J. C. F. Hopkins, B.Sc. (Lond.), Plant Pathologist.

3/32. No. 848 Mycological Notes: Seasonal Notes on Tobacco Diseases: 3, Frog Eye; 4, White Mould; by J. C. F. Hopkins, B Sc. (Lond.)

4/32. No. 850. Pests of Stored Tobacco in Southern Rhodesia, by M. C. Mossop, M Sc., Entomologist.

6/32. No. 856. A List of Plant Diseases occurring in Southern Rhodesia, Supplement 2, by J. C. F. Hopkins, B.Sc. (Lond), Government Plant Pathologist.

9/32. No. 861. Further Notes on Leaf Curl of Tobacco in Southern Rhodesia, by J. C. F. Hopkins, B.Sc. (Lond.), Plant Pathologist.

11/32. No. 868. Cultural Methods and Tobacco Whitefly in Southern Rhodesia, by M. C. Mossop, M.Sc., Entomologist.

5/33. No. 892. The Tsetse Fly Problem in Southern Rhodesia, by R. W. Jack, Chief Entomologist.

5/33. No. 893. Experiments with Tsetse Fly Traps against Glossina Morsitans in Southern Rhodesia, by R. W. Jack, Chief Entomologist.

6/33. No. 894. Mycological Notes. Seasonal Notes on Tobacco Diseases. 6. An Unusual Type of Frog Eye Spotting, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A., Government Plant Pathologist

6/33. No. 896. A List of Plant Diseases occuring in Southern Rhodesia. Supplement 3. (New Records for period June, 1932, to May, 1933.) Compiled by J. C. F. Hopkins, B.Sc. (Lond), A.I C.T.A., Government Plant Pathologist.

7/33. No. 897. The Report of the Chief Entomologist for the year ending 31st December, 1932, by Rupert W. Jack, F E.S., Chief Entomologist.

8/33. No. 899. The Black Maize Beetle (Heteronchus Licus Klug), by C. B. Symes.

2/34. No. 911. Screw Worm. A Pest of Ranch Cattle in Southern Rhodesia, by A. Cuthbertson, Entomologist. Foreword by R. W. Jack, Chief Entomologist.

3/34 No. 913 Locusts· Instructions for dealing with Flying Swarms, by The Division of Entomology.

4/34. No 917. The Life History of the Screw-worm Fly, by Alexander Cuthbertson, Entomologist.

10/34. No 934 Mycological Notes. Seasonal Notes on Tobacco Diseases 7, Spraying in Seed-beds and Lands, by J. C. F. Hopkins, D Sc. (Lond), A.I.C.T.A., Senior Plant Pathologist.

12/34. No 938 The Destruction and Control of Locust Hoppers, by R. W. Jack, Chief Entomologist

1/35. No. 942 Mycological Notes Seasonal Notes on Tobacco Diseases. 8, The Mosaic Mystery. 9, Danger Points in Field Spraying, by J. C. F. Hopkins, D.Sc. (Lond), A.I C.T.A., Senior Plant Pathologist.

4/35. No. 950. The Control of Tsetse Fly in Southern Rhodesia, by Rupert W. Jack, Chief Entomologist.

4/35. No 951. Suspected "Streak" Disease of Maize. Notice to Growers, by J. C. F Hopkins, D.Sc. (Lond), A I C.T.A., Senior Plant Pathologist.

6/35 No. 957. Annual Report of the Branch of Plant Pathology for the year ending 31st December, 1934, by J. C. F. Hopkins, D.Sc. (Lond), A.I C.T.A., Senior Plant Pathologist.

8/35. No. 962. The Report of the Chief Entomologist for Year ending 31st December, 1934, by R W. Jack, Chief Entomologist.

10/35. No. 969. The Objects and Value of Seed Treatment of Maize against Diplodia, by G. M. Wickens, Ph.D. (Lond.), D.I.C., Assistant Plant Pathologist.

5/36. No. 986. Annual Report of the Division of Entomology for year ending 31st December, 1135, by Rupert W. Jack, Chief Entomologist.

7/36. No. 993. Annual Report of the Senior Plant Pathologist for year ending 31st December, 1935. Part I.: Plant Pathology. Part II.: Tobacco Research, by J. C. S. Hopkins, D.Sc. (Lond.), A.I.C.T.A., Senior Plant Pathologist and Officer in Charge of Tobacco Research Station, Trelawney.

12/36.	No. 1011.	Tick Infesting Domestic Animals in Southern Rhodesia, by Rupert W. Jack, Chief Entomologist. Revised, November, 1936.
7/37.	No. 1037.	Division of Entomology: Annual Report for year 1936, by R. W. Jack, Chief Entomologist.
8/37.	No. 1040.	A Programme for the Control of Diseases of Apple Trees in Southern Rhodesia, by J. C. F. Hopkins, D.Sc. (Lond.), A.I.C.T.A., Senior Plant Pathologist.
10/37.	No. 1047.	Mycological Notes: Seasonal Notes on Tobacco Diseases. X.: Precautionary Methods in Seed-beds, by J. C. F. Hopkins, D.Sc. (Lond.), A.I.C.T.A., Senior Plant Pathologist.
12/37.	No. 1050.	An Unusual Winter Outbreak of Maize Weevil *Calandra oryzae*, L.), by M. C. Mossop, M.Sc., Entomologist, Department of Agriculture.
2/38.	No. 1059.	A Poison Bait for Young Locust Hoppers.
6/38.	No. 1071.	Common Diseases of Apples and their Control in Southern Rhodesia, by J. C. F. Hopkins, D.Sc. (Lond.), A.I.C.T.A., and Aline L. Bacon, B.Sc., Division of Plant Pathology.
6/38.	No. 1074.	A Note on a Stem Rot of Sweet Peas, by J. C. F. Hopkins, D Sc., A.I.C.T.A., Senior Plant Pathologist.
7/38.	No. 1078	Mycological Notes: Seasonal Notes on Tobacco Diseases. II. Two Destructive Curing Moulds, by J. C. F Hopkins, D.Sc. (Lond.), A.I.C.T.A., Senior Plant Pathologist.
8/38.	No. 1079.	Annual Report of the Branch of Plant Pathology for the year ending 31st December, 1937, by J. C. F. Hopkins, D.Sc. (Lond.), A.I.C.T.A., Senior Plant Pathologist.
8/38.	No. 1080.	Annual Report of the Division of Entomology for the year ended 31st December, 1937, by Rupert W. Jack, Chief Entomologist.
9/38.	No. 1082.	The Life History of Root Gallworm or Root Knot Eelworm, by M. C. Mossop, M.Sc., Entomologist.
10/38.	No. 1086.	The Spraying of Tobacco Seed-beds and Control of Rosette Disease, by J. C. F. Hopkins, D.Sc. (Lond.), A.I.C.T.A., Senior Plant Pathologist, and M. C. Mossop, M.Sc., Entomologist.
1/39.	No. 1097.	Cleanliness Aids Insect Control: Some Examples of Agricultural Hygiene, by M. C. Mossop, M.Sc., Entomologist.

POULTRY.

1/29.	No. 721.	Poultry Keeping in Rhodesia: Pedigree Breeding, by H. G. Wheeldon, Assistant Poultry Expert.
4/29.	No. 738.	Hints to Breeders: Rearing Young Stock, by A. Little, Poultry Expert.
6/29.	No. 740.	Artificial Incubation, Breeding and Rearing of Chicks. by H. G. Wheeldon, Poultry Expert.
11/29.	No 761.	Housing and Feeding of Adult Stock, by H. G. Wheeldon, Poultry Expert.
10/30.	No. 795.	The Turkey, by G. H. Cooper, Assistant Poultry Officer
1/31.	No. 803.	Geese, by G. H. Cooper, Assistant Poultry Officer.
9/31.	No. 827.	The Ideal Brooder, by F. Roberts, Assistant Poultry Officer.

10/32.	No.	865.	Poultry Industry: Care of Young Stock in Hot Weather, by H. G. Wheeldon, Chief Poultry Officer.
11/32.	No.	870.	Trap Nests, by B. G. Gundry, A.I.MechE. (combined with No. 875).
12/32.	No.	872.	The Rearing and Fattening of Table Poultry, by H. G. Wheeldon, Chief Poultry Officer.
3/33.	No	884.	The Vitamins in Poultry Feeding, by G. H. Cooper, Poultry Officer, Matopo School of Agriculture and Experiment Station.
5/34	No	918	The Moulting of Poultry: The Normal and Pullet Moult, by H. G. Wheeldon, Poultry Officer.
12/34.	No	939.	The Use of Galvanised Iron in the Making of Some Appliances for Poultry Keeping, by G. H. Cooper, Assistant Poultry Officer, Matopo School of Agriculture and Experiment Station.
12/34.	No	940.	A Cheap Portable Colony House for Poultry, by G. H. Cooper, Assistant Poultry Officer, Matopo School of Agriculture and Experiment Station
3/34.	No.	947	Modern Culling of Laying Hens, by G. H. Cooper, Assistant Poultry Officer, Matopo School of Agriculture and Experiment Station
9/35.	No	966.	Egg Marketing Bill: Draft of a Bill having for its purpose the more orderly Marketing of Eggs.
11/35.	No.	971.	Feeds for Poultry and How to Use Them, by G. H. Cooper, Assistant Poultry Officer.

The following pamphlets can be obtained from the Poultry Officer upon application:—

Selecting Birds for Laying Tests, by A. Little, Poultry Expert.

Tuberculosis, by A. Little, Poultry Expert.

Prevention of Disease among Poultry, by A. Little, Poultry Expert.

Preparing Birds for Show, by A. Little, Poultry Expert.

The Fowl Tick (Argas persicus), by A. Little, Poultry Expert.

Culling: A Seasonal Operation, by A. Little, Poultry Expert.

Choosing a Male Bird, by A. Little, Poultry Expert.

The Breeding Stock, by A. Little, Poultry Expert.

Diseases of the Digestive System, by A. Little, Poultry Expert.

Mating for Improvement and Increased Egg Production, by A. Little, Poultry Expert.

Partial Moult: Broodiness. Selection of Layers of Large Eggs, by A. Little, Poultry Expert

Exhibiting Eggs at Shows, by A Little, Poultry Expert.

Condition of Birds on Show, by A. Little, Poultry Expert.

Green Food: The Result of not Supplying Sufficient to Poultry, by A. Little, Poultry Expert.

Good and Bad Hatching Eggs, by A. Little, Poultry Expert.

Grading Fowls, by A. Little, Poultry Expert.

Housing: Three Important Essentials, by A. Little, Poultry Expert.

Advice to Prospective Poultry Farmers, by A. Little, Poultry Expert

Seasonal Hints—August, by A. Little, Poultry Expert.

Successful Chick Rearing, by H. G. Wheeldon, Assistant Poultry Expert.

Hints to Breeders, October, by A. Little, Poultry Expert.
Abnormalities in Eggs, by A. Little, Poultry Expert.
Hints to Breeders. Prepare for the Breeding Season, by A. Little.
Respiratory Diseases, by A. Little, Poultry Expert.
Selection and Preparation of Fowls for Exhibition, by H. G. Wheeldon, Poultry Expert.
The Close of the Hatching Season and After, by H. G. Wheeldon, Poultry Expert.

7/38. No. 1075. The Artificial Incubation, Brooding and Rearing of Chickens, by H. G. Wheeldon, Poultry Officer.
11/38. No. 1090. A Cheap Portable Colony House for Poultry, by G. H. Cooper, Assistant Poultry Officer.
12/38. No. 1092. Feeding and Drinking Appliances for Poultry, by G. H. Cooper, Assistant Poultry Officer.

METEOROLOGICAL.

12/22. No. 436. The Possibility of Seasonal Forecasting and Prospects for Rainfall Season, 1922-23, by C. L. Robertson, B.Sc., A.M I.C.E.
12/24. No. 524. The Use of an Aneroid Barometer, by C. L. Robertson, B.Sc., A.M.I.C.E.
2/25. No. 532. The Short Period Forecast and Daily Weather Report, by C. L. Robertson, B.Sc., A.M.I.C.E.
6/25. No 542. Review of the Abnormal Rainfall Season, 1924-25, by C. L. Robertson, B.Sc., A.M.I.C.E.
10/28. No. 712. The Time, and How to Find It, by N. P. Sellick, M.C., B.Sc. (Eng.).
10/31. No. 832. The Weather Map and the Short Period Weather Forecast, issued by the Meteorological Office.
2/33. No. 877. Clouds and Weather in Southern Rhodesia, by N. P. Sellick, M.C., B.Sc., Meteorologist.
3/35. No. 948. The Weather, contributed by The Meteorological Office.

AGRICULTURAL BUILDINGS.

4/26. No. 588. Concrete on the Farm, by N. P. Sellick, M.C., B.Sc. (Eng.), Assistant Irrigation Engineer.
8/26. No. 605. Flue-curing Tobacco Barns. Bulking and Grading Sheds, by P. H. Haviland, B.Sc. (Eng.), Acting Government Irrigation Engineer.
5/27. No. 644. Tobacco Baling Boxes, by B. G. Gundry, Irrigation Branch.
11/27. No. 661. Flue-curing Tobacco Barns, 12 ft. x 12 ft. x 16ft., by B. G. Gundry.
10/32. No. 863. Piggeries, by B. G. Gundry, A.I.Mech.E.
5/33. No 889. The Construction of Dipping Tanks, by B. G. Gundry, A.I.Mech.E.; and Notes on their Management, by J. M. Sinclair, M.R.C.V.S., Chief Veterinary Surgeon.
9/33. No. 902. Brick-making on the Farm, by A. C. Jennings, Assoc.M.Inst.C.E.
12/33. No. 908. A Charcoal Safe or Cooler, by B. G. Gundry, A.I.Mech.E., Irrigation Division.
5/34. No. 922. Dairy Building in Southern Rhodesia: A Small Farm Dairy, by B. G. Gundry, A.I.Mech.E.
7/34. No 926. Dairy Buildings in Southern Rhodesia. Cow Byre—Type II., by B. G. Gundry, A.I.Mech.E.
10/36. No. 1002. A Simple Farm Gate, contributed by the Division of Forestry.

5/37. No. 1031. Cattle Bale Grip.

8/37. No. 1041. Feeding Pens for Bullocks: the Layout at Estes Park, near Salisbury.

1/39. No. 1098. The "Gundry" Tobacco Furnace, by B. G. Gundry, A.I.Mech.E.

CHEMISTRY.

12/29. No. 762.—The Value of Rock Phosphate and "Bone and Super phosphate" as Fertilisers for Maize Production, by A. D. Husband, Chief Chemist.

4/32. No. 852. Mixing of Fertilisers: A Guide to Methods of Calculation, by the Division of Chemistry.

7/32 No. 858. The Softening of Waters, by the Division of Chemistry.

1/34. No. 910. The Toxicity to Grazing of Grass Sprayed with a Solution of Sodium Arsenite, by A. D. Husband, F.I.C., and J. F. Duguid, M.A., B.Sc.

9/34. No. 930. Analyses of Rhodesian Foodstuffs, by The Division of Chemistry.
Chemist.

5/35. No. 954. Experiments on the Toxicity to Fowls of Arsenite of Soda and Poisoned Locusts, by J. K. Chorley, F.R.E S., and R. McChlery, B.A., B.Sc.

4/36. No. 983. Annual Report of the Branch of Chemistry for year ending 31st December, 1935, by A. D. Husband, F.I.C., Chief Chemist.

7/37. No. 1035. Analyses of Rhodesian Foodstuffs, by The Division of Chemistry.

MISCELLANEOUS.

4/28. No. 686. The Land Bank, Its Functions and How it Operates, by S. Thornton.

4/28. No. 687. The Use of Explosives on the Farm, by P. H. Haviland, B.Sc. (Eng.).

9/28. No. 707. Wood-Charcoal in Southern Rhodesia, by T. L. Wilkinson, B.Sc., Assistant Forest Officer.

5/31. No. 820. The Great Economic Problem in Agriculture—No. 1, by J. R McLoughlin, M.Sc. (Economist), Economic Adviser.

6/31. No 823. The Law of Supply and Demand—No. 2, by J. R. McLoughlin, M.Sc. (Economics), Economic Adviser.

Twelve Simple Rules for the Avoidance of Malaria and Blackwater.

Summary of the Game Laws of Southern Rhodesia.

11/34. No. 935. The Weeds and Poisonous Plants of Southern Rhodesia, by Chas. K. Brain, M.A., D.Sc., Director of Agriculture. Part I.

8/35. No. 961. A Home-made Ridger. Contributed by Mr. Douglas Aylen, Somerset, Concession.

1/36. No. 975. Fertilizers, Farm Foods, Seeds and Pests Remedies Ordinance, 1914.

2/36. No. 979. The Prospects of Black Bass in the Inland Waters of Southern Rhodesia. Specially contributed.

6/36. No. 991. Silage and Silos.

NOTICE

The Agricultural Journal of S. Rhodesia

is issued by the Department of Agriculture, and can be obtained upon application to the Editor. The Annual Subscription, which must be paid in advance, is 5/-, and payment may be made by any means other than by stamps.

A 10/- note will cover the subscription for two years.

Persons residing outside Southern and Northern Rhodesia may become subscribers by paying 2/- in addition to the subscription, to cover postage.

If payment is made by a cheque drawn on a bank outside Rhodesia, commission must be added.

All cheques and postal notes must be made payable to the Secretary for Agriculture and Lands.

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To the Secretary,
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THE RHODESIA

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(Assisted by the Staff of the Agricultural Department).

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Editorial.

Contributions and correspondence regarding subjects affecting the farming industry of Southern Rhodesia are invited. All communications should be addressed to:—The Editor, Department of Agriculture, Salisbury. Correspondence regarding advertisements should be addressed:—The Art Printing Works, Ltd., Box 431, *Salisbury.*

Important Notice to Tobacco Growers.—Growers of flue-cured and dark fire-cured tobacco are reminded that, in terms of Section 26 of the Tobacco Marketing Act, 1936, as amended, they are required to render to the Secretary, Department of Agriculture and Lands, a return showing the estimated total weight of saleable tobacco harvested by them during the season 1938-39.

The requisite form has been despatched to every registered grower for completion and return to the Secretary, Department of Agriculture and Lands, on or before 15th June, 1939.

If any registered grower fails to render by due date the return required by Section 26, the Minister may by order cause such grower's name to be removed from the register of growers kept under the Act, whereupon that grower shall neither sell any tobacco in the Colony nor export any tobacco on consignment until his name has by order of the Minister, who shall upon receipt of the return duly completed make such order, been restored to the register.

Loss of Nitrogen from Farmyard Manure.—The following extract from *The Journal of the Ministry of Agriculture* for April this year will undoubtedly be of interest to many of our farmers.

"The response to artificial nitrogenous fertiliser by crops receiving farmyard manure is, of course, partly dependent on the 'quality' of the manure and the way in which it is handled. By taking a little trouble to reduce unnecessary losses of plant food, particularly nitrogen, from the dung, it may be possible to reduce the amount of artificial fertiliser required, though admittedly, even if all the soluble plant food is lost, the land itself will still benefit physically from the humus supplied by the dung. The biggest losses during the making of manure usually arise from failure to conserve the urine, or from the effects of too much air or too much water in the manure heap, *e.g.*, a badly made heap, too loose or made in such a way that rain runs into it and drains away from the bottom, carrying soluble plant food with it. But almost equally serious are the losses that occur during the actual application of the manure to the land, especially if it is left lying about on the surface before being ploughed or covered in. When the manure is spread on the surface of the land and left for some time before ploughing in, it may dry out completely, especially in dry, windy weather. In the course of this drying, a very large part of its available nitrogen may be lost into the air by volatilization as ammonia. Hence it is of the greatest benefit to get the manure ploughed in as soon as possible, for even the small heaps in which it is usually set out in the field are too small to prevent loss by drying-out in a drying wind, and once the manure has been spread on the surface of the ground the loss is extremely

rapid in the absence of rain. The losses that may occur during spreading are well illustrated by the following figures obtained in experiments in Germany. The complete omission of dung reduced the crop by 24 per cent., whilst leaving the dung on the surface of the land for four days before ploughing in reduced the crop by 12 per cent., giving a yield no better than the half dressing of dung ploughed in immediately after spreading. Hence half the value of the dung to the first crop was lost by leaving it on the land for four days before ploughing in. Of course, the extent of the loss must vary considerably with weather conditions—rainy weather tending to wash the available nitrogen into the soil, thereby preventing the loss of ammonia into the atmosphere.

Results of Eighth Milking Competition.—The competition commenced on the 1st October, 1937, and ended on the 31st October, 1938. Entries were restricted to farmers manufacturing butter or cheese or who supplied milk to a cheese factory or cream to a creamery. Dairymen supplying wholemilk for consumption in towns were excluded, as it was felt that the higher price paid for milk would enable them to feed their cows better than those supplying cream to a creamery or milk to a cheese factory, etc., and the latter would thus be placed at a disadvantage.

Competition "A."—For the 15 cows showing the highest milk production in a lactation not exceeding 300 days—Kilburn Floating Trophy:—

1st Prize.—W. S. Mitchell, Springs Farm, Iron Mine Hill. Average milk production per cow 9,180.4 lbs.

2nd Prize.—Mrs. E. D. Knill, Mendamu, Marandellas. Average milk production per cow 8,405.4 lbs.

3rd Prize.—Mrs. M. L. Higginson, Wendiri, P.O. M'Sonneddi. Average milk production per cow 8,237.3 lbs.

The first prize thus goes to Mr. W. S. Mitchell.

Competition "B."—For the 15 cows showing the highest average butterfat production in a lactation not exceeding 300 days—the Fischer Floating Trophy:—

1st Prize.—W. S. Mitchell, Springs Farm, Iron Mine Hill. Average butterfat per cow 304.94 lbs.

2nd Prize.—Mrs. E. D. Knill, Mendamu, Marandellas. Average butterfat per cow 303.76 lbs.

3rd Prize.—W. Sole, Bauhinia, Glendale. Average butterfat per cow 279.35 lbs.

Our congratulations are extended to Mr. Mitchell, who this year has taken both the Fischer and Kilburn Trophies.

Agricultural Show Dates, 1939:—

29th July (Saturday), Bindura.
Mazoe Valley and District Agricultural Society Show.

10th and 11th August (Thursday and Friday), Umtali Show.
Umtali and Eastern District Agricultural and Horticultural Society.

16th and 17th August (Wednesday and Thursday), Salisbury Show.
Rhodesian Agricultural and Horticultural Society.

23rd August (Wednesday), Gatooma Show.
Hartley District Show Society.

25th and 26th August (Friday and Saturday), Gwelo Show.
Midlands Agri-Horticultural Society.

1st and 2nd September (Friday and Saturday), Bulawayo Show.
Bulawayo Agricultural Society.

Treating Tobacco Seed.—Recognising the importance of using properly cleaned and chemically treated tobacco seed, this Department has for the last few years undertaken this service on behalf of the tobacco growers. The fee charged is 6d. per ounce of cleaned seed. The treatment is carried out by the Chemistry Branch, and as provision has to be made to

supply this service without interference with the other duties of the technical staff unduly, farmers are requested to send their seed for treatment as early as possible. This year the treatment of seed will be restricted to the months of July, August and September only and the seed will be treated in strict rotation.

Agricultural Cleanliness in June.—Dispose of remaining volunteers, stalks, roots and re-growth of tobacco plants. They should be collected and destroyed by fire or included in a properly tended compost heap. No further attention to tobacco seed-beds should be necessary, but make sure that they are safe. To help control whitefly, aphis, stem borer, leaf miner, cutworms, and other pests and diseases, continue ploughing tobacco lands now Clean grading sheds and such places regularly, especially in or under fittings where there are accumulations of small scraps of tobacco; burn the refuse.

Plough up onion fields as soon as possible after the crop is harvested. Continue cleanliness in garden and orchard, paying particular attention to "stung" fruit, to vegetables and flowering plants of the cabbage family that are no longer required, and to clean cultivation in general.

In field husbandry the plough is an important aid to cleanliness. The ploughing season is here; *take advantage of it by fitting your cleanliness programme in with it.* You will then be more satisfied with your ploughing, and—Cleanliness Aids Insect Control.

Veterinary Research Department

P.O. Box 657, SALISBURY.

VACCINES, REMEDIES, ETC., FOR THE INOCULATION AND TREATMENT OF LIVESTOCK.

The following vaccines and remedies will be supplied, postage or railage paid, except where specified to the contrary, *on receipt of cash or cheque*, payable to the Director of Veterinary Research :—

1. QUARTER EVIL VACCINE.
   For Cattle ... 3d. per dose.
   For Sheep ... 1d. per dose.
   (Supplied in bottles containing 10, 20, 40, 80 or 100 doses.)

2. REDWATER AND GALLSICKNESS VACCINE ... 1/- per dose.
   (Minimum supply 5 doses; issued for use only on calves under 9 months; must be used within 48 hours of preparation.)

3. HORSESICKNESS VACCINE ... 6/- per dose.
   (Issued only during advertised period, usually June-October; must be used within 8 days of issue.)

4. BLUE TONGUE VACCINE FOR SHEEP ... 1d. per dose.
   (Issued in bottles containing 12, 24, 48 and 96 doses.)

5. CHICKEN-POX VACCINE FOR POULTRY... 2/3 per 50 doses.
   (Must be used within 7 days of issue.)

6. WIRE WORM REMEDY (Powder)... 1/-per tin.
   (One tin contains 100 doses for adult sheep.)
   Set of spoons for use with above ... 6/-
   Dosing bowl for use with above ... 9d.

7. TETRAM ... ... 1 gallon tin 16/-
(Sent by rail only. Carriage forward.)
Dosing Syringe (60 c.c.) and mouthpiece for use with Tetram 17/6

8. NODULAR WORM REMEDY ... ... 1/6 per tin.
(One tin contains sufficient powder for the single treatment of 100 adult sheep.)
Set of spoons for use with above 4/6
Dosing bowl for use with above ... ... 9d.

9. IMMUNISATION OF CATTLE.

Valuable cattle can be inoculated for redwater, gall-sickness and quarter evil at the Veterinary Research Station, the charge being £5 0s. 0d. per head for Rhodesian or South African bred animals and £7 10s. 0d. per head for animals imported from other countries. This charge includes the cost of food and attendance for the duration of the inoculation period, which is approximately 6 weeks to 2 months.

N.B.—Application for this service must be made in advance, as the number of animals which can be dealt with is dependent upon the accommodation available from time to time. Every animal sent in for inoculation must be equipped with a strong leather headstall and a good riem, failing which such equipment will be purchased by the Department at the owner's cost.

10. BLOOD SAMPLES.

Pipettes and preservative for the collection of blood samples for contagious abortion testing of cattle and bacillary white diarrhoea and fowl typhoid testing of poultry are supplied on request.

Note.—No refund will be allowed for vaccines, etc., returned. Every care is exercised in the preparation and distribution of vaccines and remedies and in the treatment of stock under inoculation, but the Department does not accept any responsibility for losses incurred as a result of the use of such products or services.

The Rhodes Inyanga Estate

This Estate was bequeathed by Cecil John Rhodes in trust for the people of Rhodesia. For a long time it was administered directly by the trustees of his will, but in 1918 administration was delegated to the Department of Agriculture. Until 1933 farming operations were carried out. Various types of trees were planted, chiefly near the Homestead, cattle and sheep were run on the Estate and large apple and pear orchards were established.

Much valuable information was obtained from this experimental work, but in 1933, due partly to the surplus of cattle in the country and partly to the depression and consequent losses involved, these operations were largely abandoned in favour of the development of the area as a tourist resort. Much valuable work is still being carried on, and this will be referred to later.

Somewhere over 100,000 acres in extent and lying at an altitude of over 6,000 feet, the climate is an extremely bracing one, and the scenery quite different from anywhere else in Southern Rhodesia.

The air is clear and in every direction can be seen magnificent mountain scenery, while from the slopes of these mountains beautiful perennial streams descend rapidly. The Estate itself has been frequently compared with the English Downs, and although the vegetation is ranker and the elevation very much higher, the description is in many ways an apt one. It is, however, more broken than the Downs, due to the streams, which have in course of time formed deep valleys and even precipitous gorges. These streams are frequently intersected by waterfalls, notable among them being the Pungwe Falls well over 1,000 feet in height, the Inyangombie Falls and the Nyamziwa Falls.

The Inyangombie Falls are actually just off the Estate, but the other two are within its boundaries.

Rhodes's intention when taking up land in this area was to include within his estate the magnificent Pungwe Falls, but later it was found that they were just outside the southern boundary. Consequently, in 1938, an area of 550 acres surrounding the Falls was purchased and is now incorporated as part of the Estate. The Falls are now proclaimed under the Monuments and Relics Act.

Two means of approach to the Estate are available to the tourist, namely, from Rusape and from Umtali. Undoubtedly the scenery encountered on the approach from Umtali is the finer, but this road, although satisfactory in dry weather, is the more difficult and is best avoided in wet weather.

There is an hotel on the Estate formed from the old Homestead and included in which is the room regularly used by Rhodes on his visits. Further afield is the Guest House at Inyanga Village and a country hotel about 6 miles away towards Rusape.

The Estate has also undertaken the erection of Rest Camps at beauty spots here and there, and four of these have now been completed. Consisting each of three rooms with separate kitchen and storeroom, they are furnished with a stove, four beds and mattresses, a hurricane lamp and several tables and chairs. For people who prefer camp life but who are unable to carry tents and beds, these huts are a boon.

Wood and water are supplied and the charges are 5s. per night or 30s. per week. Huts cannot be hired normally for more than a fortnight, and it is often necessary to book them well in advance. Application should be made to the Manager, Rhodes Inyanga Estate, P.B. Rusape, or if by telegram to Inyangombie, Umtali.

A notable improvement still being carried out and extended is the provision of more and better roads. Until recent years few roads existed and, in fact, only consisted of the road from Rusape to Inyanga village, the road to Umtali and a short length of road to the most central of the ancient "forts."

Since then, however, greatly increased facilities have been provided for the motorist.

The highest point on the Estate and, in fact, in Rhodesia, is Mt. Inyangani, the summit of which is 8,517 feet above sea level, or nearly twice that of Salisbury. It was decided to construct a road to give closer views of this magnificent mountain and to provide another means of approach to the Pungwe Gorge. A circular road has therefore been constructed and is still in course of improvement. Thirty-five miles in length, it is possible to traverse in a morning some of the most magnificent scenery in Africa. Leaving the hotel, the road passes through the orchards and underneath "Fort" Hill, occupied at some unknown date by a people who, although they apparently were compelled to defend themselves by the construction of such forts or laagers, spent their more peaceful times in agriculture in the lower lying land, as is witnessed by the numerous terraces and furrows still in existence, the like of which could not be bettered by engineers with modern levels to-day.

Passing through open grassland dotted here and there with plantations of wattle and pine, the road approaches the base of the Inyangani "Massif." Here can be seen the sources of the two rivers Pungwe and Nyamziwa tumbling down the all but precipitous sides within two hundred yards of each other. These rivers rise 1,000 feet or more above the road in the same swamp, but owing to the presence of an insignificant ridge, they divide and flow in opposite directions. The Pungwe retains the dignity of its own name all the way to the seas at Beira, but the Nyamziwa shortly joins the Inyangombie, which in its turn flows into the Ruenya and the Zambesi. Here also may be seen patches of coniferous forest (*Callitris whytei*) and there are few other places in the Colony where this "softwood," the only coniferous wood indigenous to Rhodesia, grows.

Travelling onwards one catches glimpses in the far distance of Portuguese territory, lying thousands of feet below and extremely flat in appearance, except when it is relieved by isolated kopjes. Farther still the edge of the Pungwe Gorge is reached, and it is a fascinating experience to look down almost 2,000 feet sheer to the tiny ribbon of water and the dense bush at the bottom of the Gorge, dotted

here and there with native kraals and with midget figures working in the lands. Few white men have had the opportunity of descending into this other world, and the paths leading down to it are few and far between.

Soon the road drops rapidly to the drift across the Pungwe and two of the rest huts previously mentioned.

Downstream, but difficult of access, are the main falls, but about a quarter of a mile upstream are others which, although only about 30 feet in height, are well worth a visit. Crossing the causeway (it is not a drift any longer), the main Umtali-Inyanga road is reached, although by a short but steep and tortuous ascent, and the circuit can be completed back to the hotel through belts of wattles and pine. On reaching the main road, a short detour of about 1½ miles towards Umtali brings the motorist to a point from which a magnificent view of the Pungwe Gorge and Falls can be obtained.

No words can suitably express the beauty of this drive, but it is necessary to utter a word of warning to those motorists who are used to town streets and stripped roads. It is constructed for motorists and not for wagon traffic or loaded lorries. In consequence it is, in many parts, very steep with hair-pin bends, and steep drops on the outer edge necessitate caution. This high country receives more than its fair share of rain, and although the road is annually repaired after being closed during the rains, much of it is and will remain rough. To those who remember the wilder tracks in Scotland and Devon, such as Amulree and Porlock Hill before it was tarred and regraded, Inyanga roads will present no terrors, but to others it is as well to point out that a speed of ten to fifteen miles per hour on the steep portions and the use of lowest gears are advisable, more especially when hair-pin bends or steep gradients are encountered.

Among other roads constructed are those to the Inyangombie Falls, well known from photographs, and the Nyamziwa Falls, where another rest hut has been constructed. Further roads are planned and are designed to open up a considerable stretch of river now stocked with trout.

Trout fishing is now becoming the major attraction on the Rhodes Inyanga Estate. Some five years ago ova were obtained from Kingwilliamstown and hatched on the Estate in the Inyangombie River system. Since then, further quantities of ova have been obtained annually, and in each case have been transported successfully on their long railway journey, packed in ice, which is renewed at the main stopping places by railway officials and others interested in the establishment of trout in the Colony. Although the rivers are at present by no means fully stocked, a great deal of good sport has already been obtained and a fish of 7¼ lbs. was caught last year. The species chosen for the Inyangombie River system was the rainbow trout, but the Estate is fortunate in having two systems. Acting partly on expert advice, and partly with a view to experimentation, steps are now being taken to stock the Pungwe system with brown trout. Thus it is hoped, within a few years, to have upwards of 60 miles of what may come to be regarded as the finest fishing in Southern Africa. Already it is possible to catch fish in over 20 miles of sparkling streams. At the present time the season extends from 1st October till Easter Monday, and the cost of a licence is 3s. 6d. per day, 7s. 6d. per week or one guinea for the season. Surely a fisherman's paradise.

Attempts are at present being made to introduce game birds, and in 1938 eggs of English pheasant were obtained both by air from England and from a breeder in Bulawayo. The birds, which were kept in captivity for breeding purposes, appeared to thrive, but unfortunately were all killed recently by a marauding leopard which broke into the large pen.

Further efforts will, however, be made, and in addition the Chikor or Indian Partridge is to be tried.

Game birds and animals are at present scarce on the Estate, but it is nevertheless an almost annual occurrence for lions to visit the area. One or two of these animals appear to move up during the dry season from Portuguese territory and are frequently responsible for losses among native cattle.

Work on the Estate, however, is not confined to the creation of amenities for the tourist and sportsman, and a considerable amount is being done which may one day prove,

and in fact has already proved, of benefit to the agricultural community. One of the first steps undertaken by Rhodes was the establishment of orchards, and by his example a profitable industry is rapidly growing in the Inyanga district. Pears and apples thrive in this part of the world, and the Inyanga trade mark is quickly becoming well known throughout the Colony. In addition to these orchards, experiments have been commenced with various berry fruits, such as blackberries, raspberries, strawberries, currants and gooseberries. It is hoped that one day this may lead to a more self-contained series of jam factories, and a widened selection of fruits for the Rhodesian consumer. Numerous varieties of nut-bearing trees are also on trial.

Here also are being established pasture grass plots under irrigation which may lead the way to the better development of the sheep industry, which has already made a successful start.

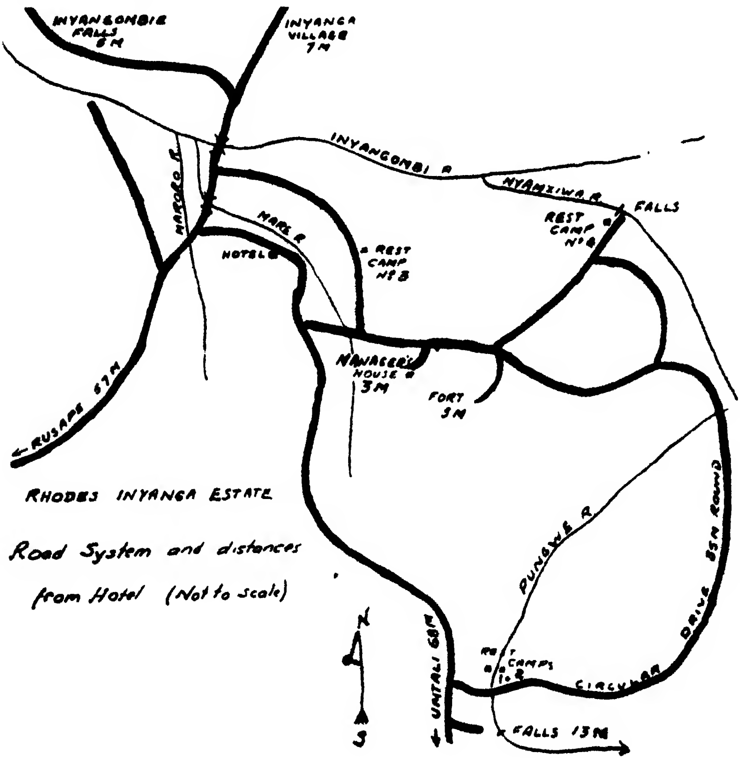
Exotic forest trees of numerous species are to be seen on the Estate, and, in fact, the evidence provided by the early plantings was largely responsible for encouraging the Government to adopt its extensive afforestation scheme on the Stapleford Forest Reserve. Planting of trees is being continued with different and more recently introduced species on different soils and at different altitudes.

No article on the Rhodes Inyanga Estate, however brief, can conclude without some mention being made of the relics of an ancient civilisation so widely scattered over the district. Relatively little scientific work has as yet been done in this area, and a vast field of exploration awaits the archeologist.

On the Estate itself are no less than eight forts situated on hilltops, and it is remarkable that each of these can be seen from any of the others, although, in some instances, they are separated by many miles.

Below these forts and scattered in apparently haphazard fashion are the "slave pits" or pit circles as they are called. These pits are 6—10 feet deep and are paved at the bottom and the walls lined with bonded stone. A sloping entrance is provided traversing the wall by a narrow archway, and on the opposite side may be found a drain.

In the neighbourhood of these are the terraced lands, on the hillsides, obviously used at one time for the cultivation of crops. Instead of the contour ridges of to-day they are protected by stone retaining walls. Generally a perfectly graded water-furrow can be seen leading to these terraces, some of which are many miles in length.



Trees and Wild Flowers.

ON THE RHODESIAN FARM.

By CHAS. K. BRAIN, M.A., D.Sc., Director of Agriculture.

PART VI.

The Baobab. *Adansonia digitata* Linn. Fam. *Bombacaceae.*—The Baobab, or Cream of Tartar Tree, is certainly the outstanding feature of the lowlying parts of the country. The valleys of the Zambesi, Sabi and Limpopo are the home of the Baobab. There Mopani and Baobab are by far the most common trees. From May to November the Baobabs are leafless and in this condition they are certainly among the most grotesque of all trees. An old tree, and no one seems to be able to guess how old such a tree might be, may be up to 70 feet high and the enormous smooth, red-barked boll may be 30 feet in diameter. (Fig. 42.) The small branches are curved and give the impression that they might be roots and that the tree is really standing on its head. When the large divided leaves appear the appearance is completely changed, and the large deep green domes of Baobab show up above the other trees like large umbrellas. The large pure white flowers appear early and are very much like a single Hibiscus flower in form. The fruits, which hang from stout stalks, are about five or six inches long and almost egg-shaped. The hard shell is felted with short hairs outside and contains a number of seeds embedded in white or yellowish powdery pith which has an acid flavour, *i.e.*, the so-called Cream of Tartar. The bark of Baobabs supplies the natives with a fibre which can be spun into cloth, made into mats or used for tying the woodwork of their huts. It is often stated that very young Baobab trees are never seen, and the fear is expressed that present-day conditions are unsuitable for these

trees and that the species will, in time, become extinct. The real explanation is, however, that the very young trees are difficult to distinguish, as the form of both the trunk and the leaves is quite different from that of the older trees. Although there are six species of the genus *Adansonia* known in the Tropics of the Old World, only one extends as far south as Southern Rhodesia. The wood of our Baobab is not wood at all in the usually accepted sense of the word and cannot be used for timber. The whole trunk is a network of fibrous material and almost sponge-like in texture. When large trees have to be cut down to make way for a road it has been found that an ordinary axe is not nearly so effective as the small native implements, as the fibre is so springy.

The Sabi Star. *Adenium multiflorum* Klotz. Fam. *Apocynaceae.*—The Sabi Star, or the so-called Dwarf Baobab, is one of the most interesting plants in our flora. Although there are about a dozen species of *Adenium* found in Central Africa, this is the only one which is found in Southern Rhodesia. Its true home seems to be the Lower Zambesi, but it is also common in the Sabi Valley. It requires conditions similar to those which favour the true Baobab, but it has been introduced into a number of gardens and seems to be able to adapt itself to all types of soil. During the dry season it is leafless and its peculiar branches certainly remind one of the Baobab. Just before the rains it puts out its flowers, which vary from pale pink to red and then later in summer, when the flowers have died, the leaves are produced. (Fig. 43.) It will be noticed that this plant belongs to the same family as several poisonous plants dealt with earlier in this series. This is also almost certainly poisonous and the juice of the branches is reported to have been used by natives as an arrow poison.

The "Kaffir Boom." *Erythrina* spp. Fam. *Leguminosae.*—There are about 36 species of the genus *Erythrina* which are found throughout Africa from North to South. Of this number it is generally considered that only three occur at all commonly in Southern Rhodesia. The common species around Salisbury is *Erythrina tomentosa* R.Br., which usually produces a medium-sized rounded tree. It flowers usually from August to October when it is leafless, but a few

Fig. 42 - Baobab *Adansonia digitata* Linn. Photograph by Eugene Marais, Esq.

Fig 43 - *Adenium multiflorum* Klotz Sabi Star From a water colour by Miss Agnes Strickland

Fig 44 —Flower and leaf of "Kaffir Boom," *Erythrina tomentosa* R Br Salisbury Commonage

Fig. 45. *Schizolobium excelsum* Vog. The tall Brazilian tree in Salisbury Public Gardens.

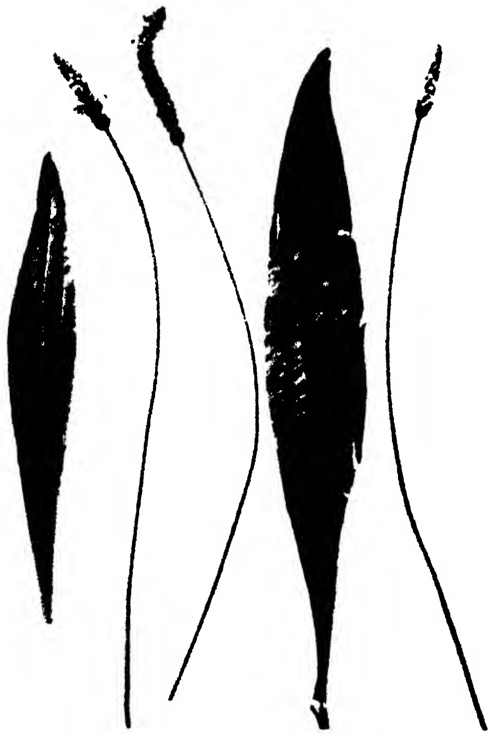


Fig. 46 *Plantago lanceolata* Linn. An introduced weed

branches often bear some flowers much earlier before all the leaves have fallen. The trunk is covered with rough, cork-like bark and the branches often have sharp but thick spines. The leaves consist of three fairly large leaflets which are felted with very short hairs below. The flowers form dense spikes (Fig. 44) which open from below. They are easily distinguished from the Eastern Border species by the fact that in *tomentosa* the calyx is divided at the apex into five fingerlike segments often reaching half an inch or more in length. In the other species the calyx is only shortly toothed. The seed pods are constricted between the seeds into globular segments each containing one "lucky-bean" like seed. The pods of *tomentosa* are broader than those of the Eastern Border species.

The second common species is that already referred to as the Eastern Border species. This has previously been determined as *Erythrina humei* E. Mey., but there still seems to be some uncertainty about its correct name. According to Dr. Burtt Davy and also to Mr. E. G. Baker in his "Leguminosae of Tropical Africa," *Erythrina caffra* occurs in Southern Rhodesia, and Baker transfers some plants previously named *E. humei* from the Eastern Border to *E. caffra*. Both these authorities consider the tree form as *E. caffra* and state that *E. humei* is a shrub. Further, the leaf stalk is not spiny—or only occasionally with one spine in *E. caffra*, while in *E. humei* both the leaf stalks and also the larger leaf veins bear spines below.

The Kaffir boom grows readily from poles, and a number of visitors to the Eastern Border have established this species in their gardens in this way. The third species is not so well known as the other two. It only grows as a shrub or small tree, but it is easily recognised by the very large leaflets which may reach 12 inches in length. It is fairly common in the Matopos and has been found at Domboshawa. This is *Erythrina latissima* E. Mey.

The Tall Tree in the Salisbury Gardens.—A number of enquiries have been received regarding the tall tree in the Salisbury Public Gardens (Fig. 45). The general opinion seems to be that it is an indigenous tree which grows in the

forests of the Eastern Border. Unfortunately this is not the case, as it would be very nice if we could claim it as a member of our own native flora. It is *Schizolobium excelsum*, Vog., belonging to the family Leguminosae, and it is a native of Brazil. When in flower about November, the whole crown is a mass of pale yellow flowers in long panicles. In its native country it often produces a perfectly straight stem to a height of 120 feet or more.

Plantago lanceolata Linn. Fam. *Plantaginaceae*.—This is a weed introduced from England, where it is known as "Ribwort" or "Plantain." The plants live for two or more years, *i.e.*, it acts as a biennial or a perennial. The leaves are numerous, from two to twelve inches long, narrow, with 3 to 5 prominent veins which run along the whole length. In the first year the leaves lie close to the ground in a dense rosette; on old plants they are erect. The flower stalks are slender and ribbed, usually 12 to 18 inches high (Fig. 46). The flower heads are at first short and showy with their numerous cream-coloured stamens. With age they become longer forming dense, cylindrical black spikes up to 4 inches long. It flowers towards the end of summer. It prefers damp soils and becomes most troublesome along the edges of water-furrows.

Feeding Young Stock in Winter

THE EFFECT OF DIFFERENT PLANES OF PROTEIN INTAKE DURING THE WINTER MONTHS ON THE GROWTH OF BEEF STEERS UNDER RANCHING CONDITIONS IN SOUTHERNS RHODESIA.

By C. A. Murray, M.Sc. (Agr.) and A. E. Romyn, Ph.D., Division of Animal Husbandry, Department of Agriculture, Southern Rhodesia.

The annual falling off in condition of range cattle during the dry winter months is well known to cattlemen and is considered to be responsible to a large extent for the slow rate of maturity and consequent inferior quality of a large percentage of our range cattle.

As a result of a series of experiments carried out by the writers (1, 2, 3) during the years 1932 to 1937 it has been shown that the cause of this loss in condition is generally due to a deficiency of protein in the grazing during the earlier winter months and to a deficiency of both protein and energy during the later winter months.

It was also shown that young growing stock and lactating ranch cows did not benefit from the feeding of bonemeal, salt or iron supplements in the area where these experiments were carried out, and it was concluded, therefore, that the pasture, including browse, was not deficient in the minerals calcium, phosphorus, sodium, chlorine or iron.

The purchased protein supplement most commonly available in the Colony is peanut cake. This is usually expensive, and the investigations described in this report have been

carried out to determine the minimum amount of protein which could be fed to young stock during the winter months with satisfactory results and whether the young stock would benefit from the feeding of an energy supplement only.

EXPERIMENT No. I.

Experimental Animals.—Fifty uniform purchased ranch-bred grade Hereford weaners were used. They were about 15 months old at the commencement of the experiment on the 1st May, 1936. The fifty weaners were divided into five groups of 10 each. The groups were similar in respect to age, sex, type, weight and height. They were not well grown and at 15 months, at the commencement of the experiment, it will be noted that they weighed on an average only 413 lbs. per head. 1936 and 1937 were both abnormally "unfavourable winters" from a grazing standpoint.

The weaners were fed the following rations in addition to their ordinary veld grazing:—

Table I.—Feed Consumption per Head per Day.

Group	Ration.	*Protein in supplementary ration.	†Protein in supplementary ration
		lbs.	per cent.
I.	Control—No supplementary feed	—	—
II.	$1\frac{1}{2}$ lbs. Maize meal	.10	7
III.	1 lb. Maize meal + $\frac{1}{2}$ lb. Peanut cake	.27	18
IV.	$\frac{1}{2}$ lb. Maize meal + 1 lb. Peanut cake	.43	29
V.	$1\frac{1}{2}$ lb. Peanut cake	.60	40

*Protein is given as digestible crude protein.

†Crude Protein of Maize meal and Peanut cake taken as being 76% and 89% digestible respectively.

Group I. Steers at end of second winter

Group II. Steers at end of second winter

Group III. Steers at end of second winter.

Group IV. Steers at end of second winter.

The composition of the maize meal and peanut cake used was determined by the Onderstepoort Research Laboratories, Pretoria as:—

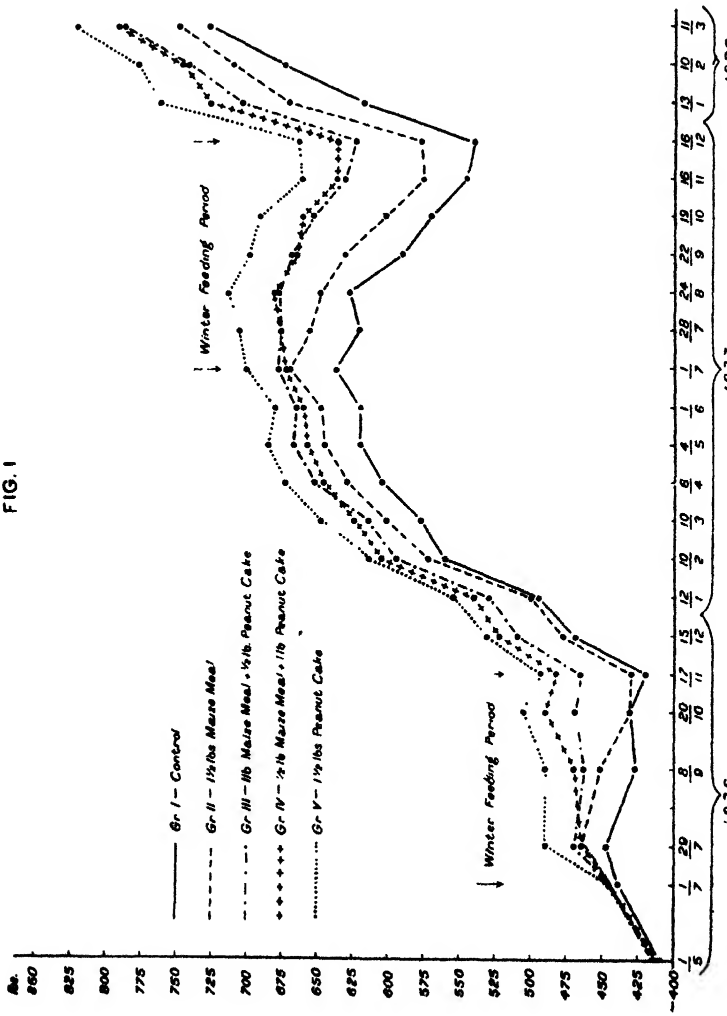
	Maize Meal.	Peanut Cake.
Moisture	9.1	7.4
Ash	1.2	4.4
Crude Protein	9.0	44.6
Ether Extract	2.3	10.4
Fibre	3.0	5.2
Nitrogen-free Extract	75.4	28.0

The rations given to Groups II. to V. inclusive have for practical purposes the same energy value. The protein intake has been varied but the amount of energy kept constant.

Management and Feeding.—The animals were grazed together throughout the experiment on free range. During the winter months, as soon as the cattle showed signs of losing condition, the supplementary feeding was commenced. All the animals were collected daily, except on Sundays, at pens which were erected in the paddock where they grazed, for this supplementary feeding. In these pens the animals in Groups II. to V. were fed their supplements *individually*, so as to ensure that each animal received its specified ration.

Results.—The average weights of the five groups of animals are given in Table II. The results are shown in graphic form in Fig. I.

FIG. I



Gr I — Control
Gr II — 1½ lbs Maize Meal
Gr III — 1lb Maize Meal + ½ lb. Peanut Cake
Gr IV — ½ lb Maize Meal + 1lb Peanut Cake
Gr V — 1½ lbs Peanut Cake
Winter Feeding Period
Winter Feeding Period
lb.
850
825
800
775
750
725
700
675
650
625
600
575
550
525
500
475
450
425
400
1936
1937
1938

TABLE II.

Average liveweight of the experimental animals at approximately 28 day intervals.

Date.		Group I. Control. (No supplementary feed.)	Group II. (7% Crude Protein).	Group III. (18% Crude Protein).	Group IV. (29% Crude Protein).	Group V. (40% Crude Protein).
		lbs.	lbs.	lbs.	lbs.	lbs.
First Winter	1/ 5/36	412	413	416	410	415
	1/ 7/36	439	446	446	445	446
	29/ 7/36	448	465	470	464	489
	8/ 9/36	427	451	463	469	489
	20/10/36	431	430	469	490	503
	17/11/36	419	430	466	483	493
First Summer	15/12/36	471	477	511	523	531
	12/ 1/37	494	500	531	539	555
	10/ 2/37	561	573	594	605	613
	10/ 3/37	578	602	616	624	648
	6/ 4/37	605	629	652	644	673
	4/ 5/37	621	645	667	657	686
	1/ 6/37	619	648	665	660	679
	1/ 7/37	637	671	677	672	699
Second Winter	28/ 7/37	621	656	675	676	705
	24/ 8/37	628	647	677	680	712
	22/ 9/37	590	629	667	665	698
	19/10/37	569	602	653	660	689
	16/11/37	544	576	630	636	659
	16/12/37	540	577	622	636	663
Second Summer	13/ 1/38	617	670	703	724	759
	10/ 2/38	672	709	740	743	776
	11/ 3/38	715	747	785	791	819

DISCUSSION OF RESULTS.

(*a*) **First Winter.**—During the first winter the feeding of the different protein supplements was commenced on 1st July, 1936, and was continued until the 17th November. At the end of this feeding period there was practically no difference in weight between Groups I. (Control) and Group II. which received 1½ lbs. maize meal. It appears, therefore, that the animals in Group II. derived no benefit from the daily feeding of maize meal. On the other hand, Groups III., IV. and V., which received additional protein in the form of peanut cake, all did very much better and weighed on the average 47 lbs., 64 lbs., and 74 lbs. heavier than the Group I. animals. The difference between Groups I. and II. and the other three groups are wide enough to be statistically significant, but the small differences that existed between Groups III., IV. and V. are not significant.

It appears, therefore, that for the purpose of wintering young stock during their first winter (1936) after weaning, the energy supplement (1½ lbs. maize meal) fed to Group II., supplying .10 lbs. digestible crude protein per day, was of no apparent benefit, while the supplements fed to Groups III., IV. and V. supplying the same amount of energy, but .27, .43 and .60 lbs. digestible crude protein respectively per day, were effective, but there was no apparent advantage in increasing the protein from .27 to .60 lbs. per day.

During the subsequent summer (17/11/37 to 1/7/38) the animals in all the groups did very well. During this period, as is usually the case, the Group I. (Control) animals made up some of the leeway on Groups III., IV. and V. For some reason which cannot be explained Group II. did better, however, during the last few summer months (10/2/37 to 1/7/38) than Group I. and on 1/7/37 actually weighed 34 lbs. heavier than Group I. and practically as much as Groups II. and IV.

(*b*) **Second Winter.**—The second winter (1/7/37 to 16/12/37) the same rations were fed to the different groups as during the first winter. At the end of the second winter the average weights of Groups I., II., III., IV. and V. were 540, 577, 622, 636 and 663 lbs., respectively. From Table II. it will be noticed that the average difference in weight between Groups I. and II. was 34 lbs. at the commencement of this winter and that it was still practically the same, 37 lbs., at the end of the feeding period. From this it seems clear that Group II. again did not receive any benefit from the feeding of $1\frac{1}{2}$ lbs. maize meal. Groups III., IV. and V. once more benefitted from the increase in protein and the three planes of intake again proved more or less equally efficient. All three groups were significantly heavier than Group I. (Control) or Group II. (Maize Meal).

It was not considered that any useful purpose would be served by continuing the experiment into a third winter and it was brought to a conclusion on 11th March, 1938, when the animals had been on good grazing for three summer months.

At this stage Groups I., II., III., IV. and V. weighed 715, 747, 785, 791 and 819 lbs. respectively. The difference of 32 lbs. (S.E. ±31 lbs.) between Groups I. and II. was not significant while the differences of 70 lbs. (S.E. ±29 lbs.), 76 lbs. (S.E. ±37 lbs.) and 104 lbs. (S.E. ±29 lbs.) between Group I. and Groups III., IV. and V. respectively were significant.

From an examination of the data in Experiment I. it appears, therefore, that:—

(1) A daily supplementary ration of $1\frac{1}{2}$ lbs. of maize meal supplying .10 lbs. of digestible crude protein did not benefit a group of young growing cattle on free range during the successive winters of 1936 and 1937.

(2) A daily supplementary ration of—

1 lb. maize meal + $\frac{1}{2}$ lb. peanut cake.

or $\frac{1}{2}$ lb. maize meal and 1 lb. peanut cake,

or $1\frac{1}{2}$ lbs. peanut cake

did benefit groups of young growing cattle during the successive winters of 1936 and 1937. These three rations were equally effective, though the digestible crude protein supplied varied from .27 to .60 lbs. per head per day.

EXPERIMENT II.

Experimental Animals.—Twenty-one Africander x Hereford weaners similar in type to those in Experiment I. were used in this experiment. They were, on the average, 15 months old at the commencement of the experiment and weighed just under 500 lbs. liveweight.

Groups.—The twenty-one weaners were divided into three similar groups of 7 per group and fed the following rations:—

Group I.—Veld grazing only. Control.

Group II.—Veld grazing, plus $1\frac{1}{2}$ lbs. maize meal daily supplying .10 lbs. digestible crude protein.

Group III.—Veld grazing, plus $1\frac{1}{2}$ lbs. peanut cake daily, supplying .60 lbs. digestible crude protein.

The rations fed to Groups II. and III. supplied the same amount of energy.

Management and Method of Feeding.—The cattle were managed in the same way as in Experiment No. I. The supplements were fed on Groups II. and III. from the 1st of July to the 16th December, 1937, during the first winter and from the 5th of May to the 17th of October, 1938, during the second winter.

The experiment was started on the 7th April, 1937, and concluded at the end of the second winter on the 27/10/38.

Results.—The average weights of the three groups of animals are given in Table III. and illustrated graphically in Fig. II.

TABLE III.

Average liveweight of experimental animals at approximately 28 day intervals.

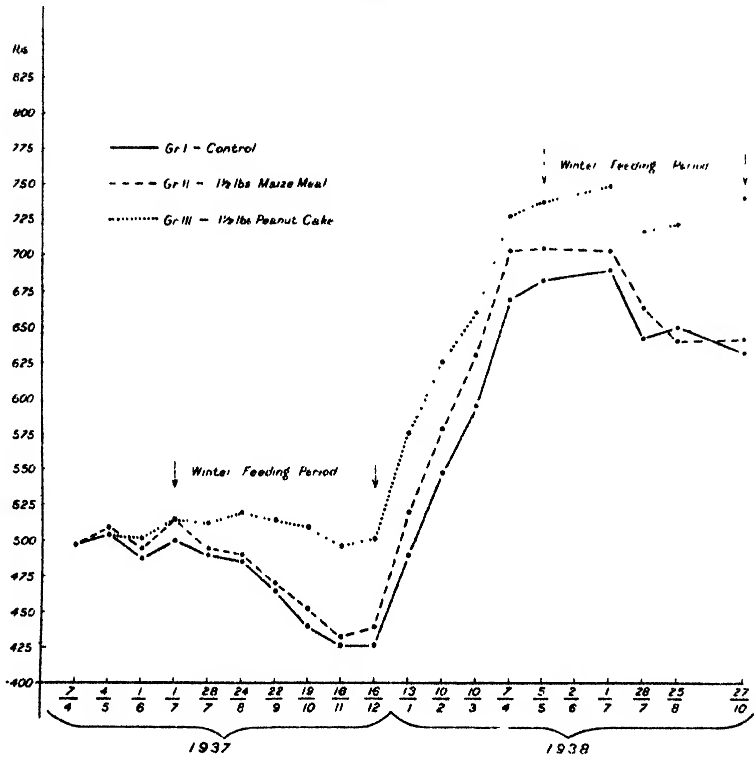
Date.		Group I. Control.	Group II. 1½ lbs. Maize meal.	Group III. 1½ lbs. Peanut Cake.
		lbs.	lbs.	lbs.
First Summer	7/ 4/37	498	498	499
	4/ 5/37	506	509	502
	1/ 6/37	487	494	501
First Winter	1/ 7/37	499	515	514
	28/ 7/37	491	495	512
	24/ 8/37	484	490	521
	22/ 9/37	465	469	516
	19/10/37	440	453	511
	16/11/37	428	432	496
	16/12/37	428	440	501
Second Summer	13/ 1/38	490	519	576
	10/ 2/38	548	580	624
	10/ 3/38	595	630	661
	7/ 4/38	669	703	727
	5/ 5/38	683	704	737
	1/ 7/38	690	703	749
Second Winter	28/ 7/38	642	664	718
	25/ 8/38	649	641	722
	27/10/38	633	643	740

From a study of the data in Table III. and Fig. II. it is clear that the Group II. animals which received the maize supplement did no better than the control group, in either the first or second winter.

Animals in Group III. were, at the end of the first winter, an average of 73 and 61 lbs. heavier and, at the end of the second winter, 107 and 97 lbs. heavier than those in Groups I. and II. respectively. These differences were satistically significant.

These results confirm those obtained in Experiment No. 1.

FIG II



General Conclusions.—From the feeding results with two groups of young cattle over a period of two winters each from 1936 to 1938 at the Rhodes Matopo Estate, Bulawayo, it is concluded that, under the conditions of these experiments:—

(1) The feeding of 1½ lbs. of maize meal containing .10 lbs. of digestible crude protein is of no apparent value to young cattle on natural veld.

(2) Any one of the following supplements, all of which have the same energy value as 1½ lbs. maize meal, is of benefit.

1 lb. maize plus ½ lb. peanut cake,

½ lb. maize plus 1 lb. peanut cake.

1½ lb. peanut cake.

They appear to be equally effective, though the content of crude protein varies from 18% to 40%.

(3) It appears that for wintering young cattle on natural grazing which contains approximately 3% crude protein (exclusive of any browse) it is necessary to supply a minimum of approximately a quarter of a pound of digestible crude protein per head per day.

(4) Both the energy and protein requirements of young stock under these conditions are apparently met by a ration, in addition to the natural grazing, of approximately $1\frac{1}{2}$ lbs. of concentrates per day containing 18% digestible crude protein.

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Because they add to your losses, insect pests are subtractors. Do not divide your crops with them, but multiply your gains by clean farming.—Cleanliness Aids Insect Control.

Soil and Water Conservation

PART II.

CHAPTER 4.—CONSTRUCTION OF SOIL CONSERVATION WORKS.

By D. Aylen and the Irrigation Officers.

STORM DRAINS.

The first line of defence against soil erosion is the storm drain, which should be constructed above all cultivated lands and in certain cases above pastoral lands, in order to prevent storm water from outside these lands reaching them and causing erosion.

It is a common fault to make these drains too small, although it is of prime importance that they should be of adequate dimensions, as a drain that is too small will overflow or burst in heavy storms with disastrous consequences to the crops and contour ridges on the lands below. For this reason it is most important that drains should be made at least of the full dimensions obtained from the diagrams Figs. 21 and 22. Even though to the uninitiated the dimensions may appear unnecessarily large, they are only barely adequate for conditions as specified.

Grades and Sizes of Drains.—For reasons of economy, it is necessary that a drain should be on as steep a grade as the formation will stand, but this easily overdone, and may lead to the formation of dangerous and costly gullies and to the depositing of silt and gravel in undesirable places. For general conditions and in formations of average toughness a gradient of 1 in 200 will be suitable. In hard and stony ground a gradient of 1 in 100 is permissible.

It is frequently necessary to carry a drain down a steep slope for a portion of the way. Several alternative methods of protection may be adopted to avoid erosion in the drain. If the formation is soft it will be necessary to instal "bolster"

Fig. 15 —Erosion in a fallow land

Fig. 16 —Sheet Erosion in a newly broken land

Fig. 17 —Downhill planting aggravates erosion.

Fig. 18 —Rilling as a result of absence of storm drain

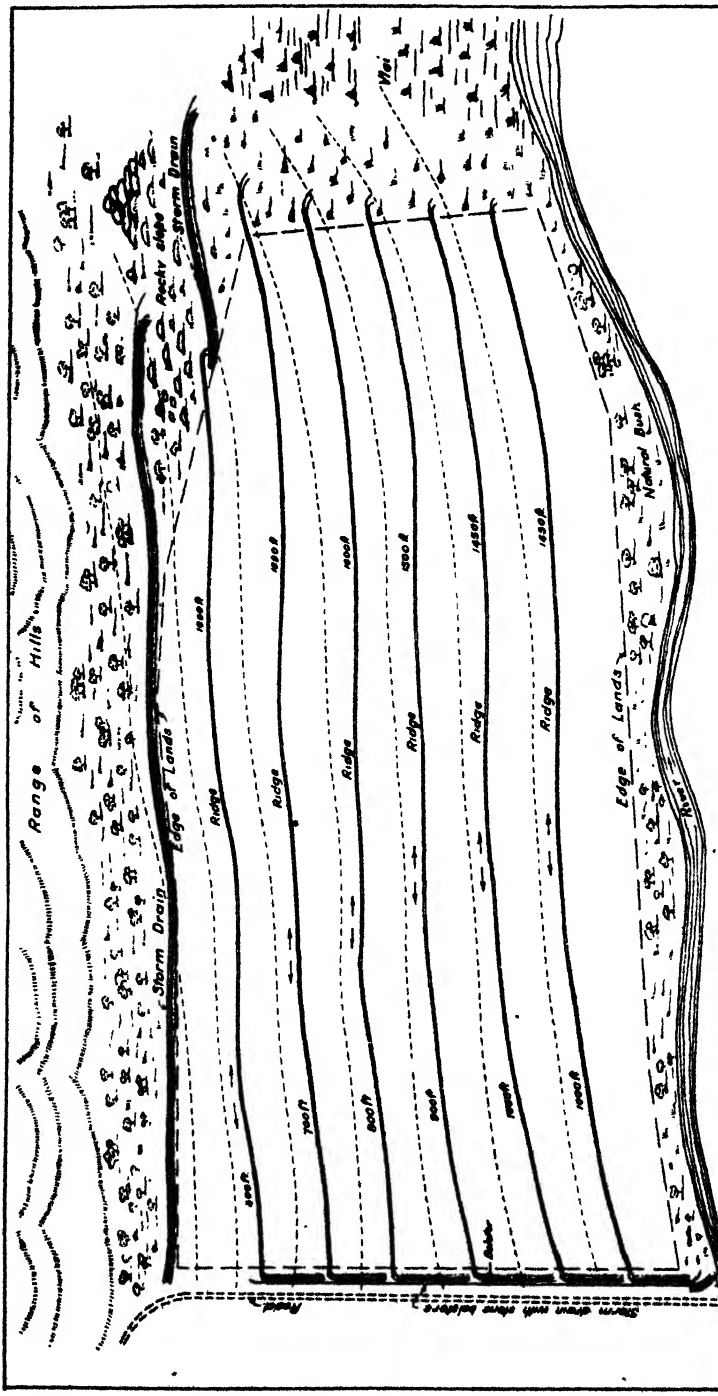
or other checks or drops at close intervals in order to maintain a non-scouring gradient. Details of methods of construction of bolsters and drops are given in a later Bulltein. In other situations it may be possible to lead the drain to the top or side of a rocky slope and allow the water to spill out and be collected in a storm drain constructed at the foot of the slope. The storm drain in Fig. 19 illustrates such a scheme. Normally, however, a drain should be constructed on an even grade throughout.

As the Type A drains (Fig. 20) have been designed to permit of a full flood rising partly up the spoil bank it is *highly important* that the bank should be constructed *and maintained* in a well-consolidated and protected condition. The toe of the bank should be at least three feet from the downstream edge of the drain as shown in the upper drawing (Fig. 20). The clear space or "berm" between the bank and edge of the drain adds considerably to its capacity and has been allowed for in the diagrams of the capacities of drains (Fig. 21) and it should be realised that the bed widths there stated are inadequate unless this berm is available. The berm also obviates the danger of the drain being blocked due to material from the bank falling into the drain.

In the case of steep land slopes in excess of 1 in 10, the carrying capacity of the berm is very small, and in these cases the size of a drain should be obtained from Fig. No. 22.

When digging a drain on a slope it is important to cant the bed of the drain *towards* the hill and away from the spoil bank, as shown in Fig. 20. This will keep the main force of the stream away from the bank, which is the weakest point, and localise any scouring that may occur at the place best fitted to stand it.

Special precautions should be taken where drains are required to cross or pick up water from a storm channel leading down from steep slopes. Such points are dangerous owing to the rush of water and the sudden deposit of silt which may choke the drain. It is frequently advisable to build a check across the channel above the drain, and these checks may be of earth or boulders, etc., with an outlet to lead the water at any easy angle to the main drain below.



Typical system of Contour Ridges & Storm Drains on 50 acre land
(Average slope of land 1 in 30 Ridges approximately 50 yds apart)

Fig. 19.

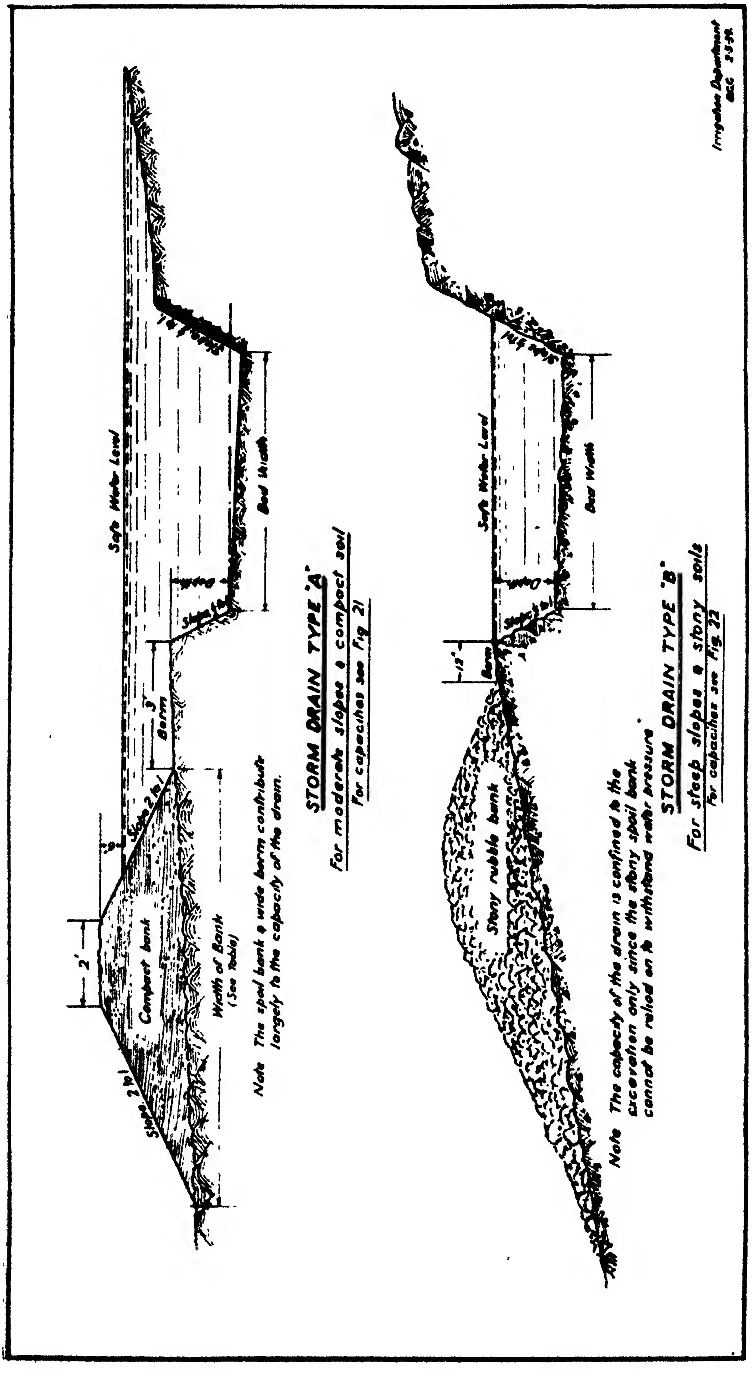


Fig. 20.—Types of storm drains.

In order to determine the adequate dimensions for a storm drain it is necessary to decide what the probable maximum flood run-off will be from the catchment area discharging into the storm drain.

This maximum flood run-off will depend on the extent of the area to be drained, its shape and nature of soil and vegetative cover.

The following can be accepted as safe approximations for the maximum flood discharge in cubic feet per second per acre for catchment areas of varying types in excess of 100 acres in extent.

Type "A" Catchment.—1 cu. ft. per second per acre. Well grassed gently sloping veld, or contour ridged arable land with absorptive soil.

Type "B" Catchment.—1½ cu. ft. per second per acre. Moderately steep veld with fair to good grass cover, unprotected arable lands with absorptive soil or contour ridged arable lands with clay sub-soil.

Type "C" Catchment.—2 cu. ft. per second per acre. Steep slopes with rock, outcrops, or steep and eroded arable lands.

For catchment areas under 100 acres in extent the above discharge should be increased by 5% for every 10 acres that the catchment is under 100 acres in extent.

For example, for a Type "C" catchment 20 acres in extent the maximum flood discharge to be adopted per acre would be 2.8 cubic feet per second $=(2+\frac{2 \times 8 \times 5}{100})$ and for a Type "B" catchment 50 acres in extent the maximum flood discharge to be adopted per acre would be 1.9 cubic feet per second $=(1.5+\frac{1.5 \times 5 \times 5}{100})$.

To utilise diagrams Nos. 21 x 22 proceed as follows:—

Assume that it is required to determine suitable sizes for a storm drain to safely discharge flood water from a Type "C" catchment 20 acres in extent, then receive the discharge from a Type "B" catchment 50 acres in extent and finally in its

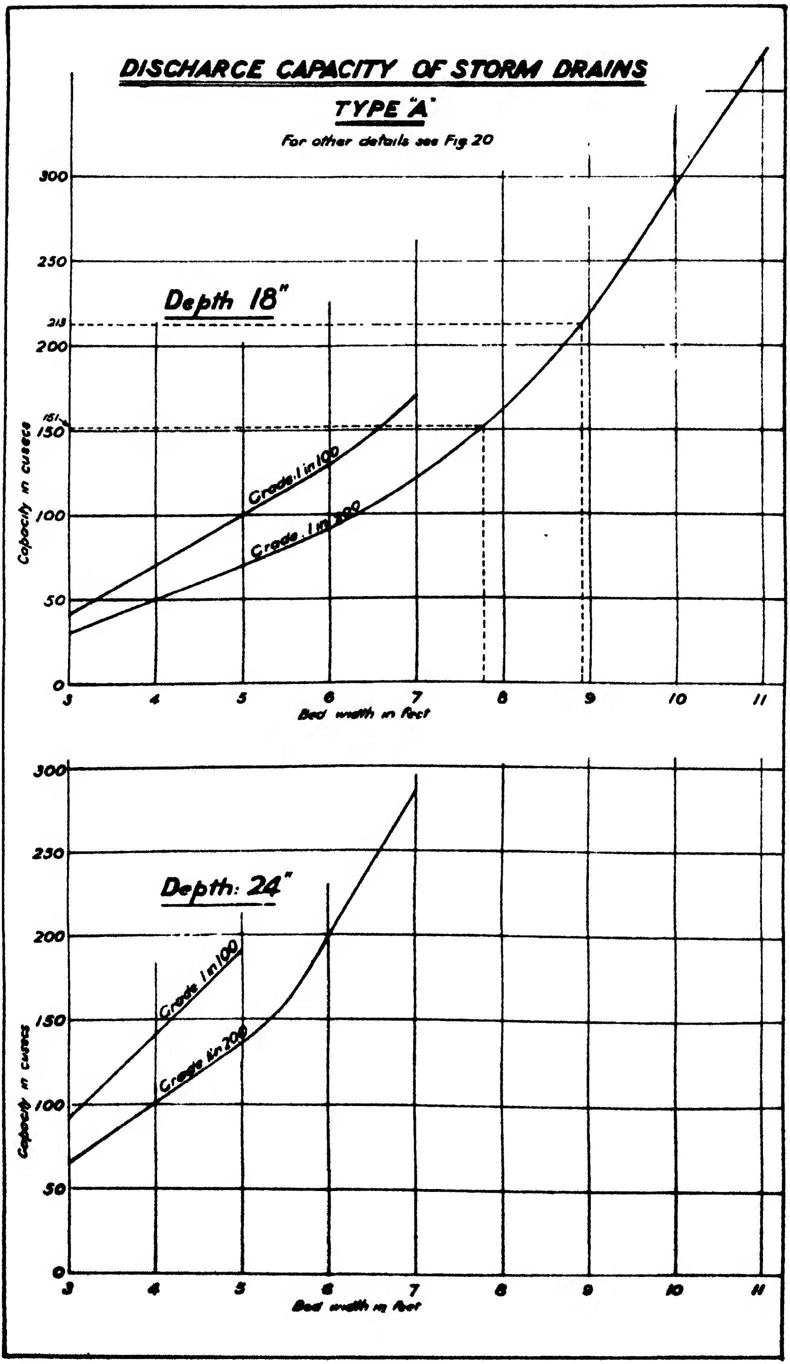

DISCHARGE CAPACITY OF STORM DRAINS
TYPE "A"
For other details see Fig 20
Depth 18"
Capacity in cusecs
0
50
100
151
150
200
213
250
300
Grade: 1 in 100
Grade. 1 in 200
3
4
5
6
7
8
9
10
11
Bed width in feet
Depth: 24"
Capacity in cusecs
0
50
100
150
200
250
300
Grade 1 in 100
Grade 1 in 200
3
4
5
6
7
8
9
10
11
Bed width in feet

Fig. 21.

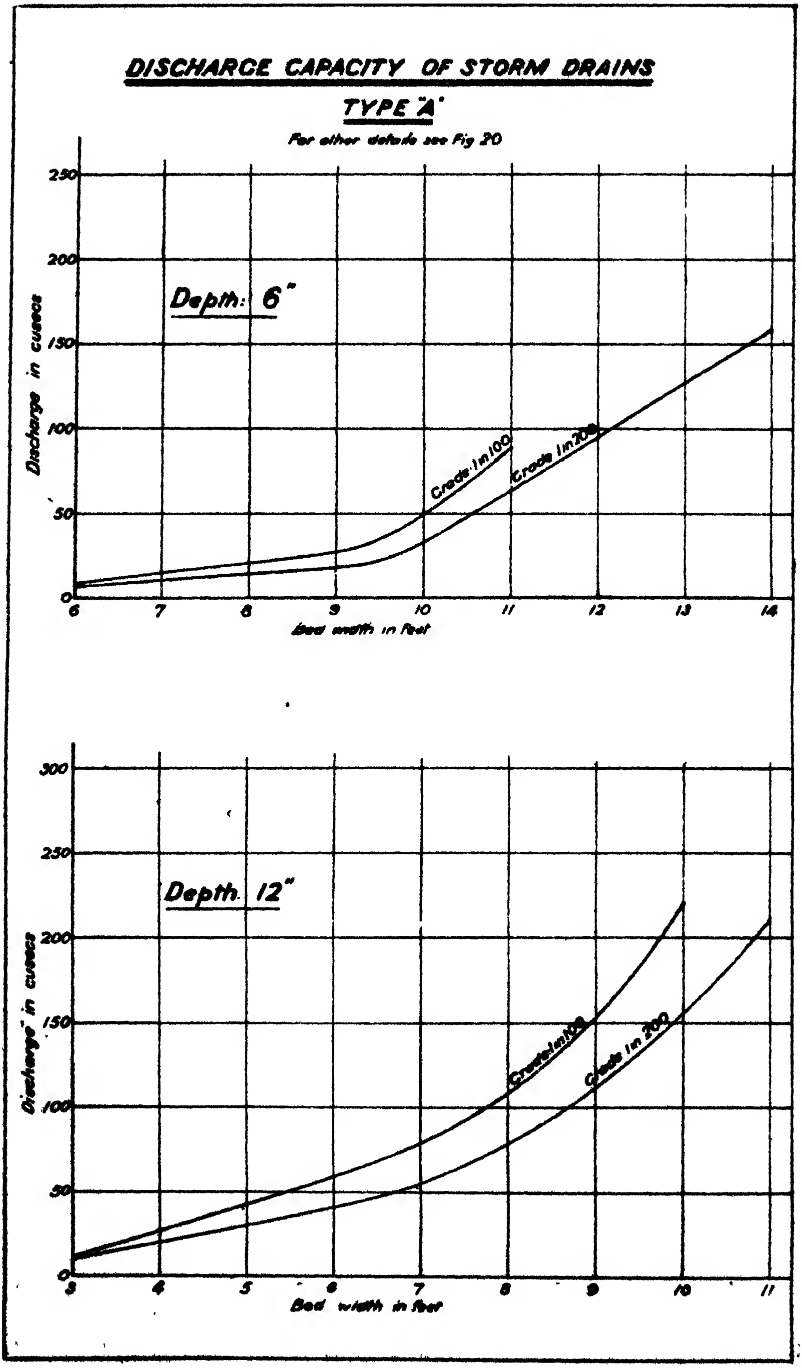


Fig. 21—(Continued).

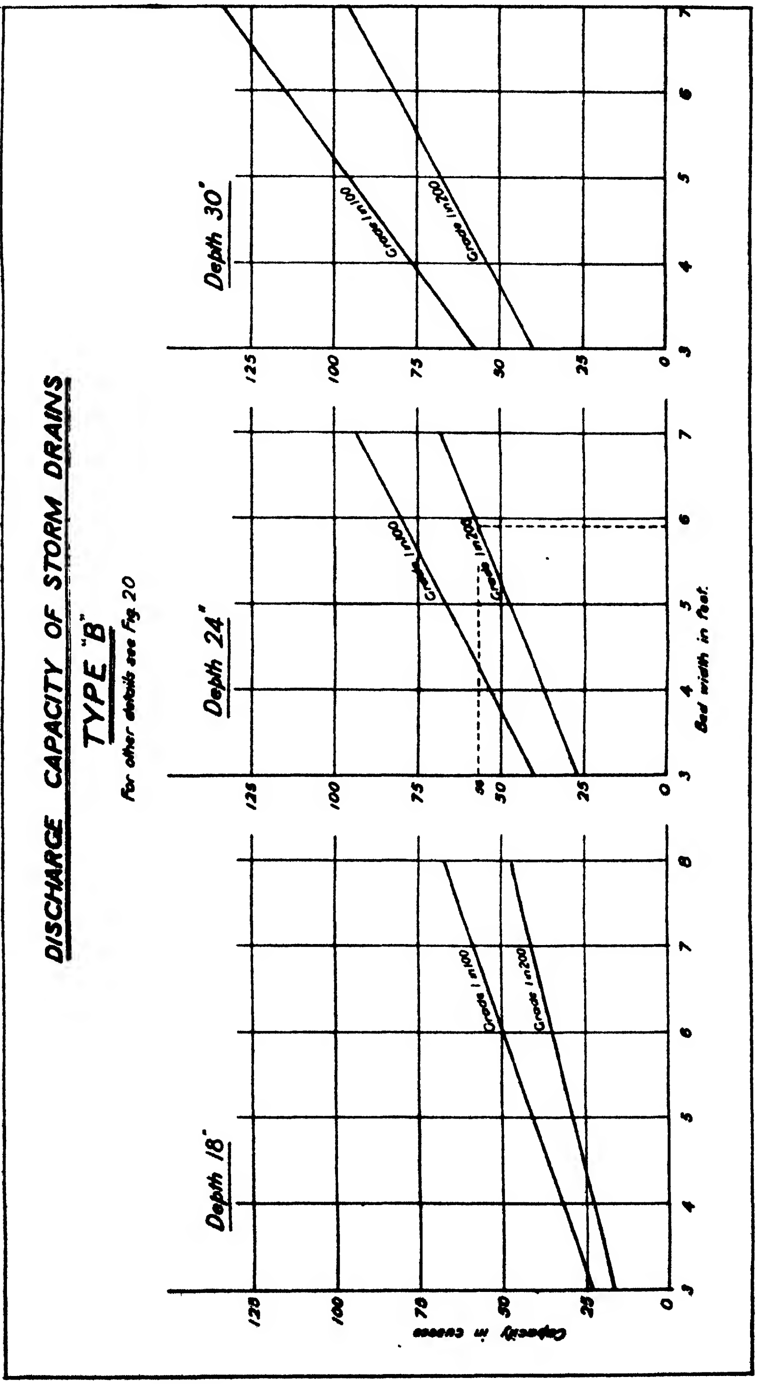

DISCHARGE CAPACITY OF STORM DRAINS
TYPE "B"
For other details see Fig 20
Depth 18"
Depth 24"
Depth 30"
Grade 1 in 100
Grade 1 in 200
Bed width in feet
Capacity in cusecs

Fig. 22.

last section before it reaches a natural outlet receives the discharge from a Type "A" catchment 50 acres in extent.

The first section will be required to deal with 2.8 x 20, *i.e.*, 56 cu. ft. per second, towards the end of the second section with 56 plus 1.9 x 50, *i.e.*, 151 cu. ft. per second and at the end of the final section with 151 plus 1.25 x 50, *i.e.*, 213 cu. ft. per second.

If it has been decided to adopt a 1 in 200 grade throughout and a "B" type drain is necessary in the first section and "A" type drains in the other two sections, it will be seen from the dotted lines in the accompanying diagrams that suitable sizes of drains will be:—

In first section bed width	6 ft.	depth 24 inches.
In second ,, ,,	8 ft.	depth 18 inches.
In third ,, ,,	9 ft.	depth 18 inches.

The above method will admittedly give flood discharge figures on the high side, as each catchment area has been treated as a separate unit and the rate of run-off per acre has not been reduced in accordance with the increase in the total catchment area.

If allowance is made for this factor the anticipated maximum flood discharge could be reduced to 132 cubic feet per second at the end of the second section and 165 cubic feet per second at the end of the final section.

It will be seen from the diagram, however, that the adoption of these figures would only effect a small reduction of less than 1 foot in the bed width, and as the figures for discharge are only empirical estimates it is as well to be on the safe side by adopting the higher figures.

It will be further seen that from the diagram that if a Type "A" catchment 120 acres in extent has to be dealt with the drain should have a final bed width of 7 feet and be 18 inches deep, as this will be capable of dealing with the expected maximum discharge of 120 cubic feet per second. If the catchment is of normal shape so that its extent increases uniformly along the drain a suitable size for the initial

section would be 3 feet bed width and 18 inches deep, as this would be capable of dealing with 30 cubic feet per second, which is slightly more than the anticipated maximum discharge for the intial 20 acres.

The diagrams also indicate that the maximum discharge capable of being dealt with by a storm drain of reasonable size, viz., 11 feet bed width and 18 inches deep is 375 cubic feet per second. This implies that the maximum catchment areas discharging into storm drains of the "A" type should be limited to 375 acres of "A" type catchments, 250 acres for "B" type catchments and about 190 acres for "C" type catchments.

This serves to emphasise how essential it is that outlets along natural drainage channels should be provided as soon as the catchments to be drained approach these limits.

In order to prevent the possibility of the spoil bank being eroded it is desirable to encourage the growth of grass on the bank, but the berm and the drain itself should be kept free of rank vegetation.

Natural Outlets.—As previously stated, storm drains should be aligned to discharge into natural outlets as soon as possible in order to limit the amount of water these drains have to discharge and thus enable their size to be kept within economical limits.

These outlets should, however, be carefully chosen to ensure that they are capable of carrying the water without setting up erosion, and left with a natural cover of vegetation, and bolstered or check-dammed if necessary.

The correct method of discharging a storm drain in veld is described at the end of a later paragraph, "Ridge outlets to veld."

Skill and experience in laying out drains will sometimes achieve the seemingly impossible, and for this reason it is important to obtain expert advice in advance, before digging drains which may do damage and handicap the general scheme of protective works on the lands below or on other parts of the farm.

Construction.—In soft formation a great deal of hand labour may be saved by stumping along the line of the drain and using the plough to break up the soil for a sufficient width. After ploughing, the soil can be thrown out by hand or a certain amount of the work done by damscoop and ditcher.

It is not generally realised that a broad, comparatively shallow drain is not only cheaper but is also less liable to scour than a deep narrow drain.

Where hand labour is necessary, the ideal system is "piece-work." The following table shows a reasonable "task" for average conditions, where hand labour only is employed, but the figures must be decreased, say, 25 per cent., for rubble or gravel, and can be doubled when the soil is soft and a plough is utilised.

Task Work in Linear Feet per Boy Day.

Bed Width.	Depth.			
	6″	12″	18″	24″
3	—	25′ 0″	19′ 6″	11′ 3″
4	—	21′ 0″	13′ 6″	10′ 0″
5	—	17′ 9″	11′ 0″	8′ 3″
6	25′ 0″	11′ 6″	8′ 0″	6′ 9″
7	19′ 0″	10′ 6″	7′ 0″	5′ 9″
8	15′ 6″	9′ 0″	6′ 0″	5′ 3″
9	11′ 6″	6′ 6″	4′ 6″	—
10	10′ 0″	6′ 0″	4′ 0″	—
11	8′ 9″	5′ 0″	3′ 9″	—
12	8′ 0″	4′ 6″	3′ 3″	—
13	6′ 0″	—	—	—
14	4′ 6″	—	—	—

Basis of Piece Work.

Up to 5 feet all depths: 4 cu. yds. = 108 c/f per boy day.

Up to 8 feet all depths: $3\frac{1}{2}$ cu. yds. = 95 c/f per boy day.

Up to 12 feet all depths: 3 cu. yds. = 81 c/f per boy day.

Up to 16 feet all depths: $2\frac{1}{2}$ cu. yds. = 68 c/f per boy day.

In the case of drains set out on land on a flatter slope than 1/10 where the berm is to be utilised for discharging flood water, it is essential that the spoil bank should be constructed to the correct shape and height. This will be achieved with the minimum of labour if the following method is adopted.

The strip for the 3 feet wide berm should first be marked out and the base width of the bank, as derived from the following table should then be measured and clearly marked. For example, if the depth of drain is to be 12 inches and the bed width 8 feet the base width of the spoil bank will be 9 feet 6 inches, or if the depth of the drain is to be 6 inches with a 12 feet bed width the base width of the spoil bank will be 10 feet.

Type of Bank Widths for Gentle Land Slopes (Type "A" Drain.)

Bed width of drain.	Feet	3	4	5	6	7	8	
Depth of drain.	6″	8′ 6″	10′ 0″	11′ 0″	12′ 0″	13′ 0″	14′ 6″	Base width of bank.
	12″	7′ 6″	8′ 0″	9′ 0″	10′ 0″	10′ 6″	11′ 6″	
	18″	6′ 0″	7′ 0″	7′ 6″	8′ 0″	8′ 6″	9′ 6″	
	24″				6′ 6″	7′ 0″	8′ 0″	
Bed width of drain.	Feet	9	10	11	12	13	14	
Depth of drain.	6″	8′ 6″	9′ 0″	9′ 6″	10′ 0″	11′ 0″	11′ 6″	Base width of bank.
	12″	10′ 0″	10′ 6″	11′ 0″				
	18″	12′ 0″	13′ 0″					
	24″							

The first lots of spoil excavated from the drain should be deposited along the downstream edge of the strip marked out for the bank and spoil subsequently excavated should be deposited along the near side of the bank thus formed until the whole width of the strip has been covered with an even layer of spoil. The bank is then raised in a similar way by depositing the spoil progressively from the far edge to the near edge of the bank. In this way the bank will almost automatically assume the correct shape without the need for double handling of the spoil and with only a minimum of trimming after the excavation of the drain is completed.

As the spoil bank is not utilised for increasing the discharging capacity of the drain on slopes steeper than 1/10, accurate construction of the bank is not of much importance but the natives should be instructed to throw the spoil well away from the bank to avoid the necessity of double handling, and leave a berm at least 12 inches in width.

Naturally on steep slopes the base width of the bank will be slightly wider than those given in the table above.

CHAPTER 5.—CONTOUR RIDGES.

Definition of Contour Ridges.—Contour ridges are low substantial banks of earth, either with or without a trough or water channel on the upperside. Fig. No. 27 gives the correct sizes for various types.

Except when designed primarily for the purposes of water conservation the contour ridges are spaced as far apart as possible, but the width of the intervals between the ridges is determined by the consideration that they should not be so far apart as to permit of water gathering in sufficient quantity to cause erosion of soil in the strips between the ridges.

The result of too wide a spacing is undue silting of the channel above the ridge. See Fig. 24.

The spacings now recommended have been found by reasonably long trials on farms to be the most satisfactory and economical, taking into consideration construction and particularly maintenance costs, and subsequent ease of farming operations. *Provided the land is correctly farmed* the ridges on these spacings should afford permanent conservation of the soil and its fertility.

Any marked terracing affect, whether caused by ploughing or deposits of silt in the channel is not to be desired, as it greatly increases maintenance costs and endangers the safety of the ridge, and results in the formation of a high steep bank on the lower side of the ridge which cannot be cultivated or crossed. An easily eroded land or one in poor condition will naturally require closer spacings. As will be

Fig 23 —Neglect of outlet drains

Fig 24 -Too wide spacing

Fig 25 —Neglect of stability at gully crossing

Fig 26. - Too steep drain.

fully explained in a later bulletin the biggest factor in controlling absorption of water and erosion is the humus content of the soil and the methods of working it.

Good farming therefore plays an important part in soil and water conservation.

In cases where contour ridges are tending to become terraces, unless specially *spaced and designed* for that purpose, intermediate ridges should be put in without delay. If this terracing effect has been brought about by using reversible ploughs continually throwing downhill they should be used solely throwing uphill until such time as the topsoil has been returned to an even depth throughout the width of the strip.

Gradient of Ridges.—The gradient of ridges may vary from a practically flat grade in regions of low rainfall where water conservation is the prime essential, to a maximum gradient of 1 in 200 (6 inches per 100 feet) in areas liable to waterlogging, but the soil must be resistant to erosion.

The practice of setting out a ridge on an increasing grade towards its outlet is now the universal practice owing to the increased safety effected by this method.

Normally the function of ridges is to remove such water as cannot be made to penetrate into the soil at such a speed as will not cause erosion, and permit the greatest possible absorption of water and deposition of silt.

In heavy soils or in soil with a clay sub-soil, there is no advantage in using almost flat grades, as the soil in the water-channel soon becomes saturated and no more water is absorbed.

In such cases it is advisable to construct the channel contour ridge type C and a variable gradient from 1/400 to 1/200 should be used. It is most important that the bed of the channel should be far more accurately pegged and constructed than is satisfactory for other types of soil. Damming of water in old gullies must be reduced to an absolute minimum, as water held in any depression does not seep away but percolates through the bank and trickles down to the next

one, with the result that the beds of all old gullies remain impassable bogs. One is thus prevented from cultivating or ploughing the land.

It is advisable in such vleis to eliminate ponding in old gullies by making the curves across them more acute than is usual elsewhere and for the farmer to fill in the remaining depression with soil which would otherwise hold water. The eveness of the bed of the channel should be checked by using boning rods as described on a later page.

The above recommendations are based on examinations which have been made as a result of complaints received on the waterlogging of land due to the construction of contour ridges, and if adopted in future should materially assist in preventing waterlogging of vlei soils.

SIMPLIFIED TABLE OF MAXIMUM SPACING AND LENGTHS.

Based on economic maintenance and reasonable safety. Loam Soils. Slight sheet erosion. No gullies. Well farmed land.

Slope of ground.	Vertical interval. Feet.	Horizontal distance. Yards.	Maximum Lengths in Yards for Variable Gradient Ridges.						
			Tobacco. 1/600 to 1/300		Maize. 1/1000 to 1/400 Type of Ridge.			Semi-Arid Districts. 1/2000 to 1/1000	
			C	D	A	B	C	A	B
1/15	6½	30	500	350			500	450	400
1/20	5½	37	,,	,,	650			,,	,,
1/25	5¼	43	,,	,,	,,			,,	,,
1/30	5	50	,,	,,	,,			,,	,,
1/40	4½	60	,,	,,	,,	500		,,	,,
1/50	4	70	,,	,,	,,	,,		,,	,,
Slopes flatter than 1/50		75	,,	,,	,,	,,		,,	,,

Note 1.—Explanation of types of ridge A, B, C and D are given on the next pages.

Note 2.—It is recommended that the flatter ridges in semi-arid districts should be be made shorter than the standard length because, though normally little run-off can be expected, this is occasionally not the case during abnormal seasons of prolonged storms, and obviously the flatter gradient has a lesser capacity.

Where greater lengths are required in semi-arid districts the gradient should be gradually increased after the 400 yard length has been passed, *e.g.*, 100 yards of 1/600 and 100 yards of 1/500. The 1/2000 gradient must only be used when soil conditions are good.

Note 3.—For vleis and other lands inclined to waterlog see previous page.

Spacing between ridges must be reduced by 15 per cent. for any one of the following conditions, plus a further reduction of 10 per cent. for each subsequent unfavourable condition:—

(1) Extensive sheet erosion.

(2) Numerous small gullies.

(3) Soil in poor condition (overcropped, badly worked).

(4) Naturally impervious soil.

(5) Naturally highly erosive soil.

Areas may be increased by 10 per cent. by a corresponding increase in either length of horizontal distance between ridges for each of the following conditions:—

(1) No apparent erosion.

(2) Good absorptive soil.

(3) Exceptionally good working of the land.

(4) Good humus content. (Regular and ample green manure, compost, etc.).

Except in cases where antheaps or outcrops necessitate an alteration the distance between ridges should not exceed those given in the table above with adjustments as recommended.

The lengths of contour ridges draining in one direction should not exceed those given unless the spacing has been correspondingly reduced so that the same area is maintained.

Dimensions and Description of various Types of Contour Ridge.—The most suitable shape of contour ridge varies according to the land slope. It is also limited to a certain extent by the method of construction and the type of farming practised, implements used and the soil type.

On steep slopes it is essential that there be a definite channel above the ridge, but at the other extreme on almost flat slopes the broad bank type is the most satisfactory for general farming purposes.

The shapes have been divided into four main classes.

Type "A."—This is the most common type of ridge and is suitable for use on loam soils with land slopes of 1/25 to 1/40.

When made to full size and later widened during the course of maintenance the bank may be planted to crops.

By taking slightly more soil from the upper side of the ridge a defined channel is formed which considerably increases the carrying capacity of the ridge.

Type "B."—This type is suitable on land slopes flatter than 1/40.

It is usually constructed by taking an equal amount of soil from both sides of the ridge, but it is advisable to clear a shallow water channel on the upper side in order to increase the factor of safety and provide for silt. The bank can be planted to crops, but both the water channel and bank should be properly maintained and this can be done by means of the plough only, if sufficient care is exercised.

Type "C."—This type of ridge is designed primarily for use in conjunction with reversible ploughs. The ploughing operations should be conducted for the first few years so that the soil is thrown uphill to ensure widening of the bank and trough to the shape shown in Fig. 27, and eventually

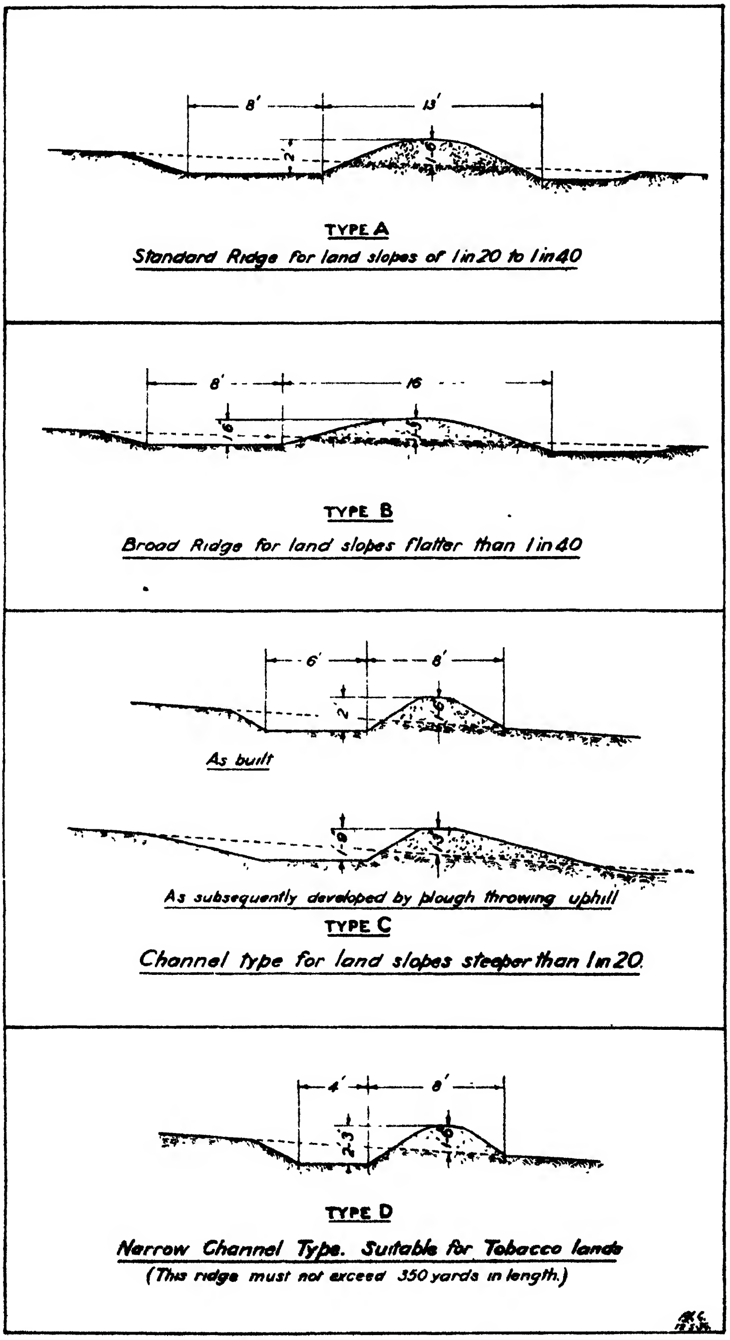


Fig. 27.—Sizes and shapes of ridges.

provides a very solid and safe structure, after which normal methods of ploughing may be adopted, provided the maintenance of the ridge is not neglected. This type of ridge is primarily intended for tobacco and steep lands and may be extended up to a maximum length of 500 yards and with "steep" variable grades and standard spacing. When the bank has attained full width it may be cultivated, but the channel must always be kept clean.

Type "D."—This type of ridge is formed by taking the soil almost entirely from the upper side and is intended for use on tobacco lands with slopes steeper than 1/25.

Its carrying capacity is much less than that of a Type "A" ridge and therefore the length draining in one direction should never exceed 350 yards.

Dimensions of Contour Ridges.

	Type A.	Type B.	Type C.	Type D.
Height, trough to bank	2′ 0″	1′ 6″	2′ 0″	2′ 3″
Bottom width of water channel	8′ 0″	8′ 0″	6′ 0″	4′ 0″
Width of the bank......	13′ 0″	16′ 0″	8′ 0″	8′ 0″
Height of bank above normal ground level	1′ 6″	1′ 3″	1′ 6″	1′ 6″

Contour ridges built to these standard dimensions will not break, but any reduction of these dimensions is false economy, as it will only result in the breaking of the ridge when the inevitable combination of circumstances occurs to produce the occasional big run-off. The ridges as recommended have been found to be only just sufficient to cope with these abnormal conditions. Such a run-off will completely fill the channel of a contour ridge built to the recommended dimensions and leave no freeboard or factor of safety.

It should be realised therefore that these recommended dimensions are the smallest which local experience has demonstrated are reasonably safe, but any reduction in the dimensions will only result in trouble and regret.

A narrow bank, even if high, is not safe, as in any event the bank slowly settles until eventually its base width is almost four times its original height with consequent lowering of the crest and fear of overtopping unless the bank is continually being made up.

The failure of a narrow bank can also result from the burrowing operations of rats or ants, as they may easily pierce right through it, and in addition a bank of this nature can soon be rendered non-effective by the trampling of cattle.

Ridge Outlets.—Defective outlets to veld are a prolific cause of broken ridges, as it is not commonly realised that any restriction in the width of the trough at the outlet will render it unable to carry the discharge from a ridge of standard length and spacing.

The correct method for discharging on to veld or into vleis is shown in Fig. 28. Just inside the edge of the land it is common to find a hollow caused by the ploughs turning, and a bank is thrown up at the actual edge. It is most important for the ridge to be built up an *extra* height across the hollow, and for the outlet drain to be cut to full depth and width through the bank.

Furthermore, a common fault is to stop the outlet short with a box-end as shown in the insert Fig. 28. The outlet should be given a greater rate of fall than the ridge and should be curved round down the slope for a sufficient distance for the bed to run out on to the ground level.

This is done by giving extra fall to the peg "B" equivalent to the depth to which the channel or drain will be excavated and placing a peg "C" at the same level as "B" and at a distance from "B" of about one and a half to twice the width of the channel at "A," "A" being the last peg on true grade. The channel is curved round and gradually widened out with the bed following the correct gradient, thus becoming shallower to finally emerge at ground level on the line BC.

This method overcomes any likelihood of serious restriction occurring at this most vunerable place without introducing the danger of erosion. A similar method is applicable

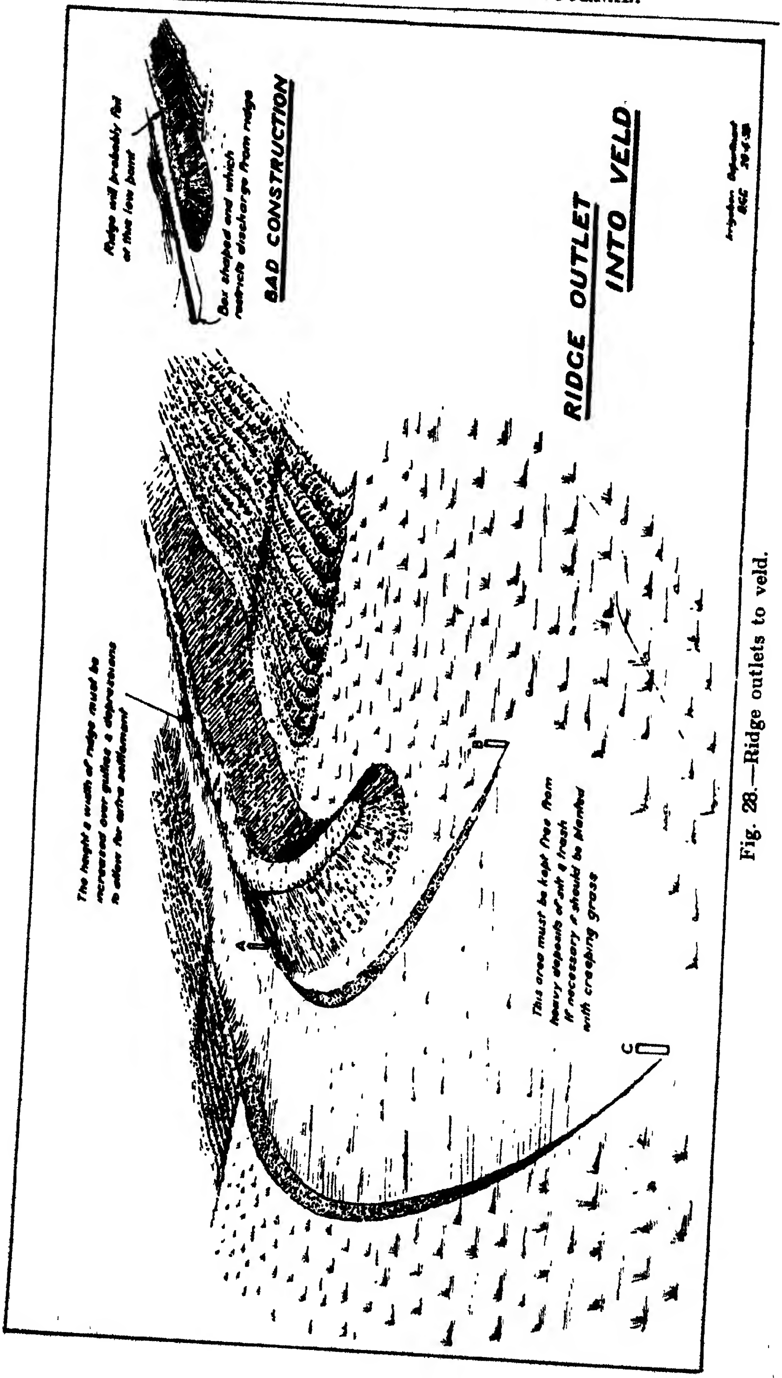


Fig. 28.—Ridge outlets to veld.

to and correct for storm drains discharging into veld, but the width "B-C" should be such that the depth of water does not exceed 6 inches.

It is important that the outlet be kept clear of trash or other obstructions to prevent the deposition of unduly high banks of silt. Particular attention should be given during the early portion of the rainy season. It is, however, sound practice in order to prevent scouring of the outlet and area below to establish a close growing grass over this area.

Outlets to Drains.—Great care must be taken when discharging contour ridges into shallow drains, especially when reliance is placed on the bank of the drain to contribute to its capacity, and also in cases where the drain not only receives the outlet water but also functions as a storm drain protecting the land (*i.e.*, the slope of the ground is from the drain towards the land).

There are various factors which only become apparent by observation during full flood conditions.

It is necessary to make sure that the water from the ridge enters the drain moving in the same direction and that the level of water in the drain is not higher than the water in the ridge.

The end of the ridge should be bent round (see Fig. 29) so as to obtain a "stream line" effect, as any swirl or check which must result from an abrupt change of direction will cause a banking up of the water in the ridge, and silt both from the drain and the ridge will be deposited as a bar across the mouth.

In numerous cases where the slope is from the drain towards the land, failures of the ridges have occurred just within the land. Checking of the levels may reveal a continuous gradient along the bed of the ridge channel and thus it is not at first apparent why breaks occur with regularity during each big storm. In such cases it will usually be found, provided there is no restriction of width of the ridge nor weakness of the bank, that the drain has been so made that during heavy storms the water runs at a considerable depth (1 ft. 6 in. deep or more) and the level of water in the

drain closely approaches or is above the level of the top of the ridge just within the land. Failure of the ridge is thus inevitable.

There are three alternatives in such a case: (1) Deepen the drain. (2) Dig a separate drain. (3) Bend down the end of the contour ridge so that it meets the drain at a place where the top of the drain bank is slightly lower than the ridge on the far side of the bend. Along the bend the bank should be gradually increased in height so that the top is level. The latter method (see Fig. 29) is usually the most practical.

In most cases the establishment of short grass in the ridge channel where it bends and meets the drain will be sufficient to control erosion, however it should be seen that the gradient does not exceed 1/200 if left bare and 1/100 if planted to grass, and in many cases such as the example above, this results in a step down from the ridge channel to the bed of the drain, which step will rapidly cut back due to erosion taking place at such times as when there is a flow in the ridge, but little in the drain. A bolster should therefore be placed along this step.

METHODS OF MEASURING CONTOUR RIDGES.

Height of Bank.—It will be noted on reference to Fig. No. 27 that the height of all types of ridges is measured from the original ground level to the top of the ridge. A simple device for checking this measurement is shown in Fig. 30. It consists of two sticks about five feet long connected by a piece of strong string of sufficient length to reach right across the ridge itself and the channels on either side. The distance from the thick end of each stick at which the string is attached must be made equal to the specified height of the ridge, *i.e.*, 15 inches in the case of the type "B" ridge and 18 inches in the case of the other types. Notches cut round the sticks at this point will ensure the string remaining in the proper place. When using this device, as indicated in the drawing, care must be taken that the sticks are held well back from the channels on either side of the ridge, and also that the butts of the sticks are not placed in a plough furrow or other depression.

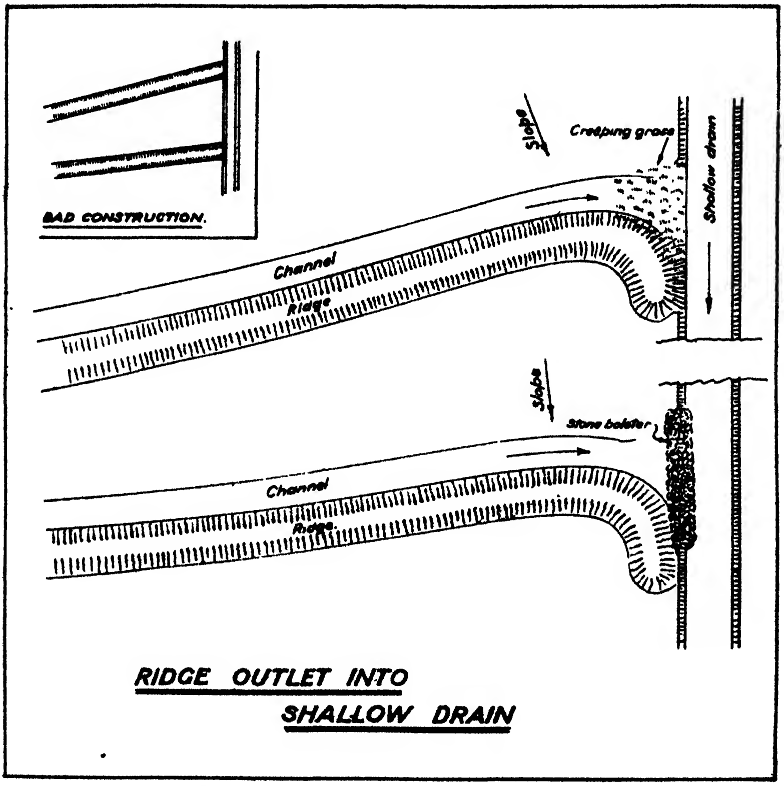


Fig. 29.—Ridge outlets to shallow drain.

Depth of Channel.—When the bank has been constructed to the full height, the depth and width of the channel should be checked to ensure that it will have the necessary water carrying capacity. The depth can be accurately measured by means of a spirit level and plank as indicated in the diagram. The plank must be straight, fairly stiff and sufficiently long to reach from the crest of the bank to at least half way across the channel. A piece of $4\frac{1}{2}$ in. x $1\frac{1}{2}$ in. deal is recommended. Any strip of wood marked to indicate the depth required can be used to check the vertical distance from the plank to the bed of the channel. The width of the channel can be checked with any piece of timber cut to the length required.

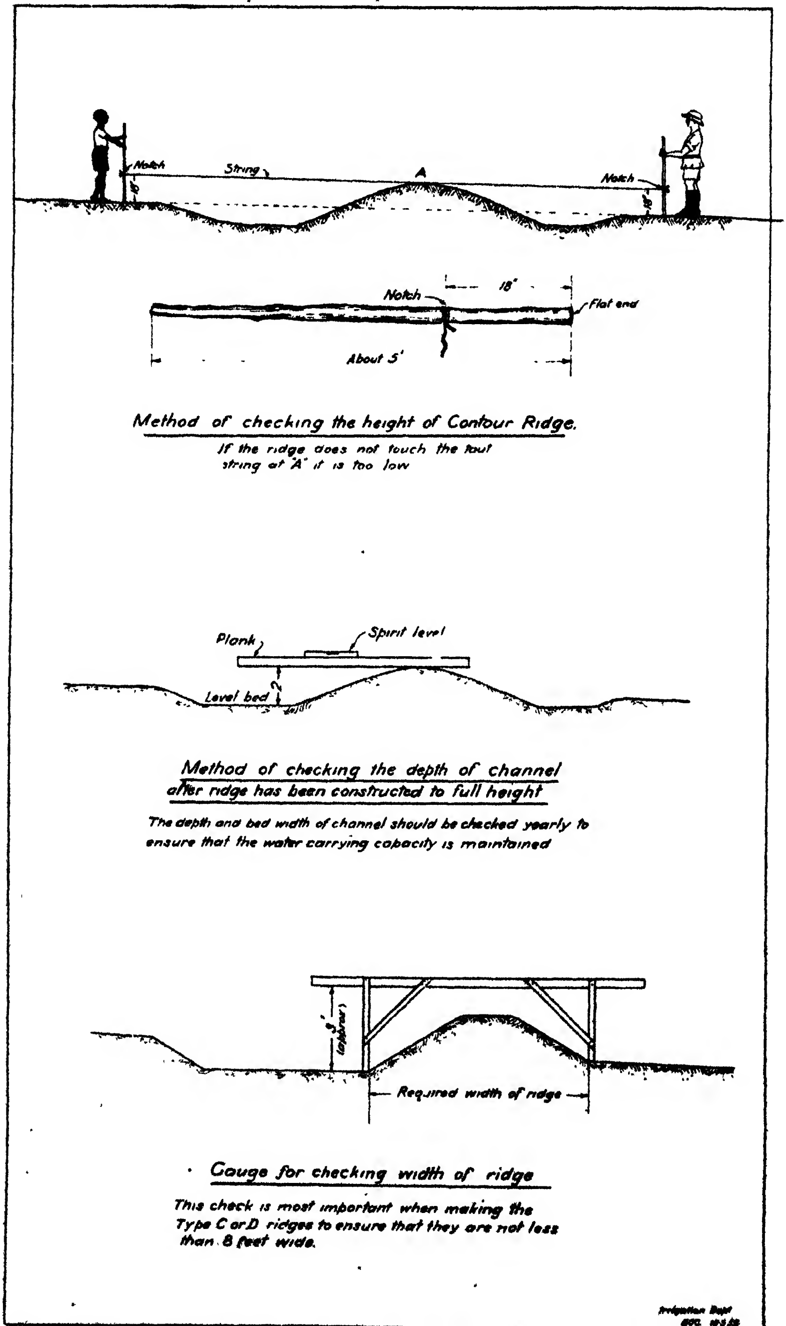


Fig. 30.—Methods of measuring Contour Ridges.

Width of Bank.—A simple form of gauge for checking the width of the bank is also shown in this figure. The horizontal bar must be fairly stiff to avoid undue bending and may be a light gum pole, or better still, a piece of $4\frac{1}{2}$ in. x $1\frac{1}{2}$ in. deal. The two vertical members and diagonal stays can be of lighter section. A gauge of this description should be used when making the Type "C" and "D" ridges, as it is considered most important that these ridges should never be less than 8 ft. wide at any point.

To the uninitiated the necessity for checking the various dimensions of contour ridges as described above may not be apparent, but the fact remains that even to men of experience a contour ridge often looks bigger than it really is and many failures have been traced to faulty judgment in this respect. The dimensions recommended and the best methods of making the various measurements have been arrived at after careful study and should not be lightly disregarded.

The Use of Boning Rods.—The use of boning rods is strongly recommended as a simple but very effective means of maintaining the necessary uniformity of gradient when trimming the beds of storm drains and the channels and banks of contour ridges. A boning rod consists of an upright plank about 5 ft. long to the end of which is nailed or screwed at right angles a cross piece about two feet long as shown in Fig. 31. A set of three such rods is required, all of which must be exactly the same height. Ordinary 4 inch flooring boards will be found a most convenient material from which to make them.

In use one rod is held by the observer, at some convenient point which is known to be at the correct level, and a second rod is held by an assistant at another point which is also known to be at the correct level. The third rod is held by another assistant at any intermediate point and the observer, by sighting a line over the cross pieces of the first and second rods can detect any error in the level at the point at which the third rod is situated.

In practice, the distance between the first and second rod may be the maximum at which the observer finds he can make reliable observations. On a straight run this will be

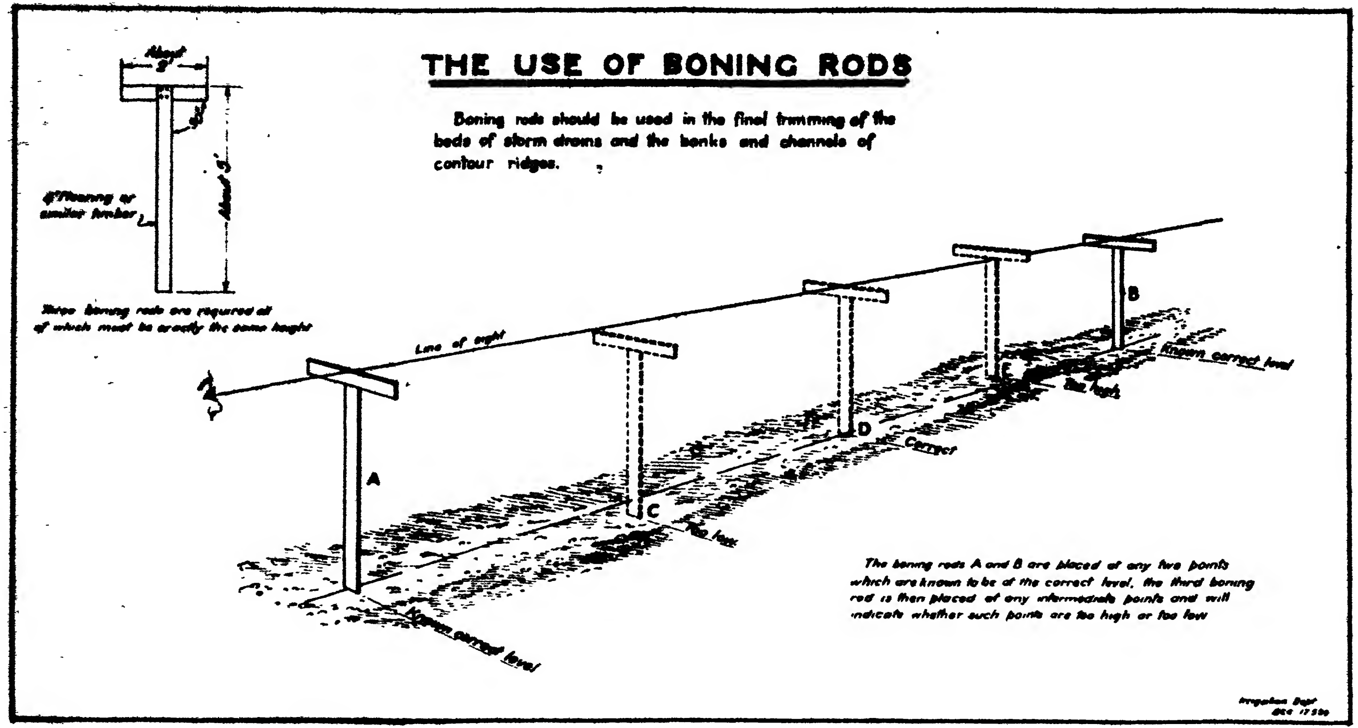


Fig. 31.—Boning Rods.

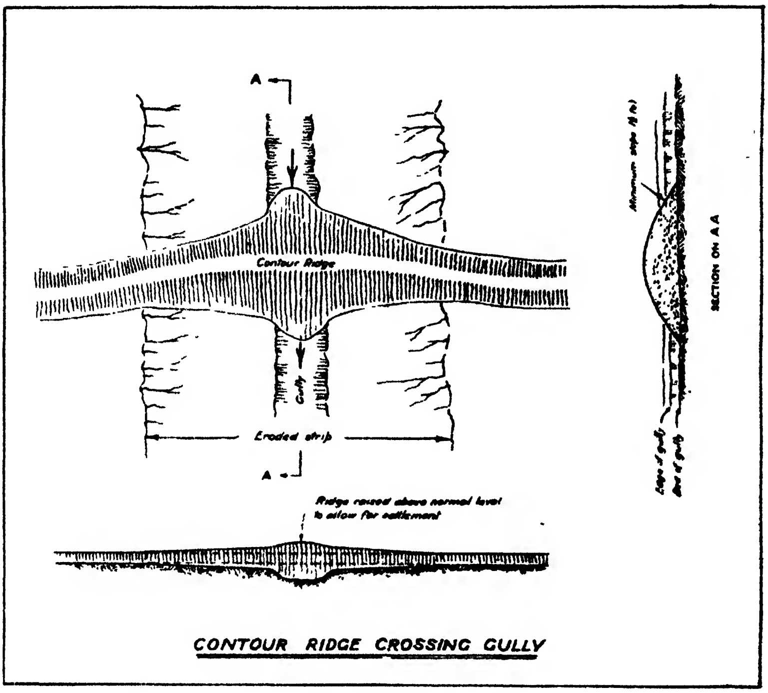


Fig. 32.—Gully crossing.

found to be about 300 feet or more, but on curves this distance will have to be reduced as the observer finds necessary. The third rod should be placed at regular intervals of from 10 to 15 feet between the other two rods until the entire distance between them has been checked. After any errors then detected have been corrected the work should be re-checked.

The String Level.—The string level consists of a small spirit level furnished with a hook at each end in such a manner that when it is hung at the exact centre point of a thin string stretched in a more or less horizontal position it will indicate whether or not the points of support at the extremities of the string are at the same level. While it has been found from experience that such levels are not sufficiently sensitive or accurate for setting out contour ridges, they are, if used with care and judgment quite suitable for setting out drains and for checking the gradient of contour ridges over comparatively short distances, as for instance, when cutting through ant-heaps, crossing gullies or when completing the outlets of contour ridges.

The string level equipment consists of a "builder's line level," fifty feet of thin cord, such as fishing line, and two planks of equal length; these should be about 2 inches by 1 inch in section and from 3 to 5 feet long.

Unfortunately these levels, which costs only a few shillings, are not always as accurate as they should be and must therefore be carefully checked in the following manner before being used. Hang the level in the centre of a string stretched between two uprights and adjust the string until the bubble is central. Now reverse the level on the string and note if the bubble is again central. If it is the level may be regarded as accurate, but if there is any appreciable difference in the position of the bubble the used must either determine what compensating allowance he must make when using the instrument which will probably lead to confusion and consequent error, or if he is a handy man he may be able to adjust the hooks himself, otherwise his best course is to obtain another level.

In operation, one of the planks is held vertically on the lower point of the gradient to be tested and the other plank at some point higher up the gradient and at a convenient distance, such as 25 or 50 feet from the first plank with the line stretched over the top of each. The spirit level is then hung on the line exactly midway between the two planks and the line is slowly lowered down the plank standing on the higher ground until the bubble of the level is central, thus indicating that the two ends of the line are level. The distance by which the line has been lowered from the top of this plank represents the amount by which the ground beneath it is higher than the ground beneath the other plank. The gradient may then be ascertained by dividing the distance between the two planks *in inches* by the distance by which the string has been lowered on the upper plank *in inches*.

For example, assume the planks are 50 feet apart and the string has been lowered by six inches, then $\frac{50 \times 12}{6} = \frac{600}{6} = \frac{100}{1}$ which represents a gradient of 1 in 100.

To set out the outlet from a drain or contour ridge which is to discharge at natural ground level, on a gradient of 1 in 200, the procedure would be as follows:—

One plank would be held at the point in the bottom of the drain or channel from which the outlet gradient starts, and the string held at a point 3 inches from the top of it. The other end of the string, 50 feet long, would be held over the top of the second plank which would then be moved up or down the slope of the ground until the two ends of the string are level as indicated by the bubble. The second plank will then be at the point where the outlet should terminate at natural ground level. It should be noted that if a string 25 feet long is used it must be held only $1\frac{1}{2}$ inches from the top of the upper plank to give the same gradient, *i.e.*, in 200.

If the land has a relatively flat slope it may be found that at a distance of 50 feet from the first plank sufficient fall is not obtainable, in which case the second plank must be lowered by digging a small depression just deep enough to allow the bubble to centre itself, then working on from this depression, the bottom of which will be on the required grade, the operation is repeated and the position of the end of the drain located.

BENEFITS OF CONTOUR RIDGES.

The primary object achieved by contour ridges is the control of erosion, and this is obtained directly by the ridges themselves and indirectly due to the fact that all farming operations on a contour ridged land must be undertaken on contours; thus every little furrow or plant row forms a check to the movement of water and so reduces erosion.

In semi-arid districts or districts with irregular rainfall the secondary benefit of water conservation is of even greater importance. By smoothing out small gullies and permitting better working of the land, a great deal more water penetrates. In producing a 10 bag per acre crop of maize 18 inches of rainfall is used by transpiration and evaporation. A 20 bag per acre crop requires that 28 inches of rain be absorbed in the soil. It is thus clear that in normal seasons moisture control by water conservation is a deciding factor in high

yield production. As much rain as possible must be made to penetrate all over the land. The effect of holding up and retaining rain water in a district of low rainfall is most striking, and this is best achieved, if the soil is porous, by constructing contour ridges with an almost flat gradient.

In addition if a land is ploughed reasonably deep, carefully worked to avoid packing of the soil, and is kept well supplied with humus, a large amount of rain will be absorbed before any run-off occurs.

Once the ground is saturated it is the function of properly designed and spaced contour ridges to remove the surplus water at frequent intervals and prevent it from moving down the slope and waterlogging the lower portions of the land. Naturally on lands liable to waterlogging and in districts of normally high rainfall the ridges are constructed on steeper gradients and a deeper than normal water channel is recommended in order that it may operate as a drainage channel during periods of excessive rain.

In such cases it is most important that any terracing effect or choking of the channel by ploughing, silting, or weed growth should be avoided.

For these reasons it can be stated that properly designed soil conservation works, *combined with good farming methods*, can to a great extent serve the dual purpose of increasing the amount of water absorbed in the soil and removing any surplus.

The benefit of improved crop yields in both above and below normal seasons can thus be attained.

It is not sufficiently well realised that sheet erosion is invisible until it has reached a really serious stage. Long before this stage is reached, however, damage will occur and crop yields be diminished owing to the leaching action performed by the movement of excessive quantities of water over the surface, which results in the solution and removal of the available soluble plant foods and the removal of the lighter particles of soil such as humus and colloidal substances. This

leaching action is one of the most potent factors in soil deterioration and can only be detected by repeated and accurate soil analyses.

By preventing the movement of soil and controlling the movement of water, contour ridges prevent fertiliser, humus and other plant food from being washed or leached away. They prevent wastage, and ensure that full value is obtained from fertilising and green-cropping so that a programme of good farming can be undertaken in the secure knowledge that it will not be mis-spent.

It is difficult enough to grow a bumper crop even in a good season. Soil and water conservation by both protective work and good farming, should make a good crop more certain even in unfavourable seasons, when prices are best. The few farmers who regularly produce yields which are relatively high for their districts will be found to practice soil conservation in the true meaning of the term.

Witchweed thrives on eroded and impoverished soil. It grows thickest on the edges of washes and small gullies. Seed is often spread by the flow of water.

Storm drains restrict witchweed infestation to a great extent by preventing water from the veld flowing over the lands and carrying the seed with it and similarly contour ridges isolate patches of infestation and prevent them spreading.

A ridged land can readily be divided up into sections to suit the various methods of control required on various parts of the land. For instance, the strips between certain ridges can be trap-cropped, and the remainder hoed to eradicate the weed.

In addition to improving the crop yield soil conservation works assist in replenishing the underground water supplies and thus are of importance for water conservation.

Much can be done to prevent erosion, in spite of unfavourable natural conditions, by recognised good farming practices, but excess water must be controlled by drains and ridges, and even when the land is completely protected good farming

practices are still most necessary. Conservation measures and good farming should go hand in hand. Much fertiliser is wasted on eroding lands. Contour ridges conserve plant food and moisture but they do not manufacture them.

Correct cultural methods, from the point of view of erosion control, involve keeping the soil in good condition and encouraging rainfall to penetrate where it falls.

It is proposed to issue a further bulletin explaining in more detail how sound farming practice and soil conservation works render mutual assistance to each other in the attainment of high fertility of the soil.

The construction and maintenance of contour ridges will follow in the next *Journal*, completing Part II.

Rhodesian Milk Records

OFFICIAL.

COMPLETED LACTATIONS.

Name of Cow.	Breed.	Milk in lbs.	B.Fat in lbs.	Average % B.Ft.	No. of days.	Name and Address of Owner.
Brightwell Rain. S.A.S.B 853, Vol. 20. 25th April, 1926	Red Poll	7622.10	218.70	2.87	278	Matopo School of Agriculture, P/B 19K Bulawayo
Matopo Drinkstone Missie I. S.A.S.B. 909, Vol. 21. 24th September, 1929 ...	Red Poll	8407.30	319.07	3.80	300	Matopo School of Agriculture, P/B 19K Bulawayo
Matopo Martlesham Circe I. S.A.S.B. 1111, Vol. 22. 5th September, 1931... ...	Red Poll	5324.90	211.41	3.97	300	Matopo School of Agriculture, P/B 19K Bulawayo

RHODESIAN MILK RECORDS.—(Continued).
SEMI-OFFICIAL.
COMPLETED LACTATIONS.

Name of Cow.	Breed.	Milk in lbs.	B.Fat in lbs.	Average % B.Ft.	No. of days.	Name and Address of Owner.
Jill	G. Friesland	4099.30	189.14	4.61	300	N. G. Barrett, Esq., Gavenny, Rusape
Blaauwberg IV.	G. Shorthorn	4949.10	211.32	4.27	287	Messrs. F. & B. Barry, En Avant, Umtali
Daisy VIII.	G.L.R. Shorthorn	4333.30	193.60	4.47	273	,, ,, ,,
Narchy III.	G. Shorthorn	7847.60	259.68	3.31	300	,, ,, ,,
Arrapence	G. Friesland	6479 20	289.60	4.32	300	J. R. Bedford, Esq., Poltimore, Marandellas
Chumi	G. Friesland	4455.10	183.65	4.12	300	
Dorothy	G.S. Devon	5998.40	257.75	4.30	300	,, ,, ,,
Madge	G. Friesland	5883.00	223.38	3.08	300	,, ,, ,,
Quilts	G. Friesland	4515.30	200.60	4.44	277	,, ,, ,,
Vitpence	G. Friesland	4401.40	196.07	4.45	277	,, ,, ,,
No. 10	G. Friesland	6191.30	221.14	3.57	300	A. L. Bickle, Esq., Box 242, Bulawayo
White	G. Friesland	8787.00	262.52	2.99	300	The Bluff Hill Dairy, Box 346, Salisbury.
Agatha	G. Friesland	5314.30	249.38	4.69	300	Lt.-Col. E. W. Brighten, Castle Base, Rusape
Bunty	G. Friesland	5570.40	194.18	3.52	300	
Bluebell	G. Friesland	4290.60	208.88	4.87	300	,, ,, ,,
Muriel	G. Shorthorn	5653.10	197.38	3.49	300	,, ,, ,,
Ursula	G. Friesland	4764.10	229.55	4.82	300	,, ,, ,,

RHODESIAN MILK RECORDS.—(Continued).

COMPLETED LACTATIONS.

Name of Cow.	Breed.	Milk in lbs.	B.Fat in lbs.	Average % B.Ft.	No. of days.	Name and Address of Owner.
No. 131	G. Friesland	4555.00	205.02	4.41	289	Coldstream Dairy, Headlands
No. 147	G. Friesland	5560.50	183.41	3.30	300	
No. 148	G. Friesland	6114.50	217.37	3.56	300	,, ,, ,,
No. 159	G. Friesland	6603.00	237.69	3.60	300	,, ,, ,,
No. 168	G. Friesland	5694.00	229.82	4.04	300	,, ,, ,,
No. 261	G. Friesland	5039.50	180.51	3.58	300	,, ,, ,,
Mabeka	G. Friesland	5041.00	181.42	3.60	271	T. Cousins, Esq., Oaklands, Gwelo
Molly...	G. Friesland	6519.60	215.87	3.31	300	
Quolly	G. Friesland	4745.70	190.65	4.02	277	,, ,, ,,
Lourensford Chorus Maid	Ayrshire	6871.50	225.49	3.28	300	E. A. L. Franceys, Umhlali, Gwelo
Moray Queen Mab	Ayrshire	6238.00	220.61	3.54	267	
Amilika	G. Red Poll	5937.20	188.11	3.16	300	Hon. H. V. Gibbs, Bonisa, Redbank
Dinah	G. Friesland	10741.20	337.27	3.13	300	
Mary	G. Friesland	8339.10	270.50	3.24	300	,, ,, ,,
She	G. Red Poll	5926.30	293.00	4.94	300	,, ,, ,,

RHODESIAN MILK RECORDS.—(Continued).

COMPLETED LACTATIONS.

Name of Cow.	Breed.	Milk in lbs.	B.Fat in lbs.	Average % B.Ft.	No. of days.	Name and Address of Owner.
Glen	G. Friesland	6094.80	222.16	3.64	300	Gower Hill Dairy, Box 1143, Salisbury
Bertha	G. Red Poll	4733.10	191.62	4.05	260	
Blackie	G. Friesland	6096.10	291.42	4.78	300	,, ,, ,,
Dolly	G. Jersey	5973.30	226.04	3.78	300	,, ,, ,,
Duchess...	G. Jersey	5807.50	241.58	4.16	300	,, ,, ,,
Effie	G. Friesland	4553.20	184.53	4.05	300	,, ,, ,,
Forgetmenot	CommonGrade	5134.10	211.70	4.12	300	,, ,, ,,
Gower Hill Pandora	G. Friesland	5026.60	189.21	3.76	300	,, ,, ,,
Laura	G. Friesland	4810.50	195.99	4.07	300	,, ,, ,,
Primrose	G. Friesland	4556.30	190.78	4.18	300	,, ,, ,,
Gower Hill Pollette	G. Friesland	8240.00	297.95	3.62	300	,, ,, ,,
Jessie	G. Friesland	5731.10	190.39	3.32	300	,, ,, ,,
Jinny...	G. Guernsey	5100.10	219.73	4.31	300	,, ,, ,,
Poll	G. Red Poll	5472.00	234.91	4.30	300	,, ,, ,,
Mtoko	G. Friesland	4939.40	217.71	4.41	300	,, ,, ,,
Query	G. Friesland	6599.20	261.69	3.81	300	,, ,, ,,
Victoria...	G. Friesland	4711.00	191.28	4.05	288	,, ,, ,,
Jam	G. Friesland	5182.90	228.54	4.41	240	Mrs. J. M. Hatt, Fairview, Sinoia
Connie II.	G. Friesland	6257.00	223.95	3.58	300	W. D. Haywood, Esq., Ordoff Farm, Gatooma
June	G. Friesland	5929.00	217.35	3.67	300	

RHODESIAN MILK RECORDS.—(Continued.)

COMPLETED LACTATIONS.

Name of Cow.	Breed.	Milk in lbs.	B.Fat in lbs.	Average % B.Ft.	No. of days.	Name and Address of Owner.
Angelina	G. Friesland	5850.50	201.29	3.44	300	Mrs. M. L. Higginson, Wendiri, M'Sonneddi
Besi	G. Friesland	7246.60	281.72	3.89	300	Mrs. E. D. Knill, Mendamu, Marandelals
Jennifer	G. Friesland	7118.10	275.24	3.86	300	
Macheke	G. Friesland	7151.70	305.70	4.27	300	,, ,, ,,
Mary	G. Friesland	6275.90	227.43	3.62	256	,, ,, ,,
Munyama	G.L.R. Shorthorn	7208.00	311.09	4.31	300	,, ,, ,,
Monkey Nuts	G. Friesland	8393.50	316.02	3.76	300	,, ,, ,,
Nesta	G. Friesland	5293.90	211.72	4.00	300	,, ,, ,,
Norah	G. Friesland	6303.50	241.90	3.84	268	,, ,, ,,
Melfort Noelle	G. Ayrshire	4857.90	185.14	3.81	282	Major A. H. MacIlwaine, Larkhill, Marandellas
Bunny II.	G. Friesland	5779.00	223.65	3.87	300	A. B. Marshall, Esq., Mimosa, Marandellas
Dolly	G. Friesland	5906.00	226.21	3.83	300	Major F. H. R. Maunsell, Forres, Bromley
No. 19	G. Friesland	6394.00	272.84	4.27	300	Mazoe Citrus Estate
No. 284	P.B. Friesland	5854.00	226.51	3.87	261	Meikle Bros., Leachdale, Shangani

RHODESIAN MILK RECORDS.—(Continued).

COMPLETED LACTATIONS.

Name of Cow.	Breed.	Milk in lbs.	B.Fat in lbs.	Average % B.Ft.	No. of days.	Name and Address of Owner.
Anneeed I.	P.B. Friesland	7443.00	235.54	3.16	300	W. S. Mitchell, Springs,
Annetta IV.	P.B. Friesland	9183.00	296.65	3.23	300	Iron Mine Hill
Cosy	G. Friesland	6916.00	246.99	3.57	300	F. B. Morrisby, Esq., Sun-
Jennifer	G. Friesland	5897.00	183.73	3.12	300	nyside, Gwelo
Patricia of Tolosa	P.B. Friesland	6167.00	204.11	3.31	293	,, ,, ,,
Snug	G. Friesland	6863.00	245.85	3.58	300	,, ,, ,,
No. 25	G. Friesland	5801.00	183.94	3.17	300	,, ,, ,,
No. 26	G. Friesland	6859.00	201.53	2.94	300	,, ,, ,,
Mafuta	G. Shorthorn	3577.30	180.53	5.04	300	H. A. Coke Norris, Laverstock, Umtali
Commiche	G. Friesland	5668.50	186.15	3.28	300	Red Valley Estate, Lushington, Marandellas
Peace	G. Friesland	5349.00	185.04	3.46	300	Red Valley Estate, "P"
Posy Pike	G. Friesland	7410.30	325.82	4.39	282	Herd, Lushington,
Pretoria	G. Friesland	5157.80	185.73	3.60	298	Marandellas.
Paradise	G. Friesland	5373.30	200.56	3.73	300	,, ,, ,,
Bimbo	G. Friesland	5877.00	208.81	3.55	300	J. D. Dill Russell, Glen
Edna	G. Shorthorn	4909.00	212.09	4.32	297	Dairy Farm, Que Que
Polly	G. Shorthorn	5609.50	253.81	4.52	286	,, ,, ,,
Babs	G. Friesland	4920.50	208.49	4.24	269	,, ,, ,,
Nesta	G. Friesland	4274.50	182.13	4.26	300	,, ,, ,,

RHODESIAN MILK RECORDS (continued).

COMPLETED LACTATIONS

Name of Cow.	Breed	Milk in lbs.	B.Fat in lbs.	Average B.Fat	No. of days	Name and Address of Owner.
Darwin	G. Friesland	4735.10	218.88	4.62	254	W. F. H. Scutt, Esq., Maple Leaf, Norton
Huclean	G. Friesland	4981.30	194.18	3.90	250	
Lucie	G. Friesland	8367.40	302.53	3.62	300	.. .. ..
Mafeking	G. Friesland	8888.90	278.80	3.14	300	.. .. ..
Magodise	G. Friesland	7810.30	289.74	3.71	300	.. .. ..
Punch II.	G. Friesland	7900.10	275.92	3.49	300	.. .. ..
Scones	G. Friesland	9936.10	338.75	3.41	300	.. .. ..
Dainty	G. Friesland	7544.60	256.57	3.41	300	W. Sole, Esq., Bauhinia, Glendale
Damson	G. Friesland	5415.60	200.20	3.70	300	
Frances	G. Friesland	6037.80	208.99	3.46	300	.. .. ..
No. 69	G. Friesland	5319.60	181.34	3.41	300	A. Stokes, Esq., Safago, Gwelo
No. 85	G. Friesland	7006.90	230.08	3.28	300	
No. 104	G. Friesland	6873.10	241.54	3.51	300	.. .. ..
No. 122	G. Friesland	6127.20	183.16	2.99	262	.. .. ..
Bluebell	CommonGrade	6119.50	250.65	4.09	300	.. .. ..
Half	G. Friesland	5928.40	228.69	3.86	287	,, ...
Rosa	G. Friesland	6986.00	246.64	3.53	300	P. S. Timms, Esq., Chitora, Rusape
White	G. Friesland	6413.00	212.78	3.32	300	
Darby	G. Friesland	5908.00	233.62	3.95	300	W. E. Tongue, Esq., North Lynn, Bulawayo
T.B. 35	G. Red Poll	4602.50	209.87	4.78	293	Tredgold Bros., Cressydale, Lydiate

Rhodesia Weather Bureau.

APRIL, 1939.

Pressure.—Monthly mean pressure was generally above normal, except in the East, where it was slightly below.

Temperature.—Mean maximum temperatures were slightly below normal, except in the East, and mean minimum temperatures were generally below, particularly in the S.W., where the deficiency amounted to 4—5° F. Dew points were generally low, particularly in the S.W., but slightly above normal in the extreme North.

Rainfall.—The monthly totals were light and in most cases below normal.

Station.	Inches.	Normal	No of Days.
Beitbridge	0.31	0.41	1
Bindura	0.45	1.61	5
Bulawayo	Nil	1.73	—
Chipinga	1.90	2.33	5
Enkeldoorn	0.30	0.72	1
Fort Victoria	0.43	0.63	4
Gwaai Siding	0.41	1.38	1
Gwanda	Nil	0.67	—
Gwelo	0.10	0.75	2
Hartley	0.81	0.87	3
Inyanga	0.61	1.23	1
Marandellas	0.27	1.43	5
Miami	2.82	1.39	6
Mt. Darwin	0.15	0.52	2
Mt. Nuza	1.35	5.19	10
Mtoko	0.18	0.61	1
New Year's Gift	0.47	1.02	4
Nuanetsi	Nil	0.62	—
Plumtree	0.01	1.15	1
Que Que	0.75	0.73	2
Rusapi	0.17	1.20	2

Station.	Inches.	Normal.	No. of Days.
Salisbury	0.56	1.05	4
Shabani	0.66	0.60	4
Sinoia	1.14	0.95	4
Sipolilo	1.17	1.19	5
Stapleford	1.02	3.82	7
Umtali .	0.23	1.14	3
Victoria Falls	0.73	0.59	2
Wankie	0.24	0.62	1
Abercorn	6.38	—	16
Balovale .	1.06	—	6
Broken Hill	0.05	-	2
Fort Jameson	2.11	-	12
Fort Roseberry	2.33	—	5
Kanchindu	0.73	—	3
Kapiri Mposhi	0 92		2
Kasama	3.04	-	9
Kasempa	0.45	-	3
Livingstone	0.59	-	1
Lundazi	1.81		12
Lusaka	0.62	-	4
Mazabuka	0.07	—	1
Mongu	0.33		1
Mpika	1.75	-	7
Mufulira	1.49	—	7
Mwinilunga	4.34		13
Namwala .	Nil	- -	—
Ndola	2.00	-	5
Sesheke .	Nil	-	—
Shiwa Ngandu	3.65	-	15
Solwezi .	1.76	-	5

APRIL, 1939

Station	Altitude (Feet)	Temperature in Stevenson Screen at 4 feet °F: 8-30 a.m. Dry Bulb.	8-30 a.m. Wet Bulb.	8-30 a.m. Dew Point	8-30 a.m. Vapour Press. Deficit	Maximum	Minimum	Max. + Min ÷ 2	Absolute Maximum	Date	Absolute Minimum	Date	Number of Days Max. > 85°	Max. < 70°	Min > 65°	Min. < 40°	Mean of 24 hours	Pressure Millibars: 8-30 a.m. Station Level	8-30 a.m. 1200 gdm.	Mean of 24 hours	Cloud Tenths	Sunshine Hours
Beitbridge...	1,486	68.9	60.4	54	9.4	86 0	57.3	71.7	96	7	39	27	16	..	2	...	70 9	966.6	884.0	964 5	2.7	...
Bindura...	3,700	66.0	60.7	57	5.8	78 5	56.5	67.5	84	8	50	28		...	...	...	67 1	..	...	...	4 2	...
Bulawayo	4,393	62.5	54.9	48	7 5	75.3	50.2	62.8	83	7	38	27	..	3	..	1	62.3	871 4	883.0	870 1	3.2	9.1
Chipinga	3,685	65.0	59.3	55	6 2	73.0	55.7	64.4	82	7	47	28	..	7	...	...	62.9	894.2	883.5	...	2 7	...
Enkeldoorn	4,808	62.7	56 5	52	6.3	75.0	52 4	63 7	82	7	45	27	...	3	...	...	62.4	859 1	883 1	...	2.2	...
Fort Victoria... ...	3,571	60.4	56.3	53	4.1	75.9	51.1	63.5	86	7	37	27	1	4	..	2	62.9	897.9	883.6	897 1	2.6	..
Gwaai Siding... ...	3,278	64.7	58.3	54	6.7	82.5	52.5	67 5	91	7	35	27	4	.	..	2	...	906.3	882.6	...	1 3	...
Gwanda...	3,233	63.9	57.0	52	7.1	77.7	52.1	64 9	88	7	35	27	2	4	...	2	63 7	908.4	883.2	...	2.8	.
Gwelo	4,629	63.3	56.0	50	7 4	74.7	51 8	63 2	81	6	42	22	...	3	...	...	62.5	864.1	883.0	..	2.6	..
Hartley...	3,879	65.1	58.8	54	6.7	78.3	52.9	65 6	84	7	45	22	..	1	.	..	64.6	887.2	882 7	...	1.8	..
Inyanga...	5,503	63 8	56.8	51	7.2	72.4	49.3	60 9	79	8	44	28	..	4	.	...	59.2	...	.	...	2.7	...
Marandellas	5,453	60.9	55.8	52	5.2	72.1	52.3	62 2	78	8	44	16	.	4	...	...	60.5	...	...	...	2.9	...
Miami	4,090	64.7	60 9	59	4.2	76 0	55.0	65.5	83	8	49	30	.	1	...	...	63.8	880 4	882.4	879 1	3 6	...
Mt. Darwin	3,179	67 6	62 8	60	5.6	79.6	56 0	67.8	87	26	48	16	1	..	...	..	66 6	...	...	...	4.6	...
Mount Nuza	6,668	54.3	51.1	48	2.8	60.7	48 0	54 3	69	24	43	28	..	30	..	...	52 4	802 5	883.2	801 9	4 5	...
Mtoko	4,136	64 9	59.1	55	6.3	73.8	56 0	64 9	81	26	51	28	...	4	.	..	64 0	879 3	882.9	877 9	3 6	..
New Year's Gift...	2,690	64 3	60 3	58	4 3	79.1	55.0	67.1	88	7	42	27	2	1	..	...	..	...	...	...	...	8 3
Nuanetsi	1,547	66.8	61 5	58	6 0	82 2	53 2	67.7	92	7	37	27	8	..	.	3	...	964 9	883.6	...	2 9	...

APRIL, 1939 (continued)

Station	Altitude (Feet)	Temperature in Stevenson Screen at 4 feet °F: 8-30 a.m. Dry Bulb	8-30 a.m. Wet Bulb	8-30 a.m. Dew Point	8-30 a.m. Vapour Press Deficit	Maximum	Minimum	Max. + Min. ÷ 2	Absolute Maximum	Date	Absolute Minimum	Date	Number of Days: Max. > 85°	Max. < 70°	Min. > 65°	Min. < 40°	Mean of 24 hours	Pressure Millibars: 8-30 a.m. Station Level	8-30 a.m. 1200 gdm	Mean of 24 hours	Cloud Tenths	Sunshine Hours
Plumtree	4,549	64.0	55.2	48	8.7	74.9	53.1	64.0	83	6	41	27	...	4	..	...	62.4	..	...	..	2.0	..
Que Que	3,999	63.5	57.2	52	6.6	78.7	53.6	66.1	86	8	45	27	1	1	.	...	65.0	883.8	883.0	882.2	2.5	...
Rusape	4,648	62.3	57.4	54	5.0	73.9	52.0	62.9	81	7	43	16		4	.		51.9				3.4	...
Salisbury	4,831	63.5	57.5	53	6.3	75.5	52.3	63.9	82	8	45	16	.	1			63.0	857.9	882.9	856.5	3.7	8.8
Shabani	3,131	65.5	58.9	54	7.1	77.0	53.6	65.3	85	6	40	28	.	..	4	..	64.2	..	..	..	3.2	..
Sinoia	3,795	65.7	60.8	58	5.4	79.6	53.8	66.7	86	8	45	22	1	.	..		65.6			..	2.5	
Sipolilo	3,876	67.4	61.5	58	6.6	77.0	54.8	65.9	81	7	49	18		.	1	...		...		.	3.4	..
Stapleford	5,304	59.3	55.8	53	3.4	67.0	45.8	56.4	75	7	37	22		19		4	56.5		...	..	3.1	.
Umtali	3,672	65.5	60.4	57	5.6	77.0	55.3	66.1	84	7	48	28	..	2		.	64.4	894.7	883.6	893.2	3.3	...
Victoria Falls	3,009	67.0	60.7	56	7.0	85.2	55.3	70.3	91	5	42	28	13	.		...	68.5	.	.		1.6	.
Wankie	2,569	67.4	61.3	57	6.8	86.9	59.4	73.2	91	7	50	28	20		1	...	72.5	928.8	882.2		1.3	...
Abercorn	5,458		.	..		.	.		...				..			...	...			...	...	.
Broken Hill	3,911	64.8	61.0	59	4.3	78.9	56.0	67.5	84	7	40	16	..			...	..	885.5	881.7	...	3.9	8.8
Chipili	3,900	67.5	64.2	62	3.9	80.5	61.0	70.8	86	8	55	16	1							...		
Fort Jameson	3,815	68.6	63.0	60	5.5	78.3	61.5	69.9	85	24	57	15	...	1	1			888.3	882.2		3.2	..
Kasama	4,562	65.8	62.4	60	3.8	77.5	60.8	69.2	82	25	56	15			...		.	...		...	...	.
Kasempa	4,500	62.9	60.3	59	2.7	78.5	53.7	66.1	83	5	45	16		1	...	..	...	.	.	.		
Livingstone	3,051	63.2	59.1	56	4.5	83.2	54.6	63.9	88	7	44	27	7		.		67.6	913.2	882.0	911.4	2.7	.
Lusaka	4,193	65.7	60.2	57	6.0	76.5	56.6	66.5	81	8	50	10		1			...	876.5	881.8	875.0	4.3	9.1
Mazabuka	3,385	67.4	62.1	59	6.1	80.3	57.0	68.6	85	7	50	29										
Mongu	3,481	69.3	61.3	56	9.3	84.8	59.7	72.3	91	7	52	27	14	.	3	.	.	898.5	881.4	.	1.7	...
Mpika	4,620	64.4	61.4	60	3.3	75.1	58.3	66.7	81	26	50	16		3	.	..	...	863.4	881.8	.	6.9	...
Mwinilunga	4,450	63.7	63.9	59	3.0	79.5	57.0	68.2	83	6	59	23		.		..	...			..	.	
Ndola	4,190	64.4	61.2	59	3.5	79.1	56.7	67.9	85	7	47	16	...	..	...	..		876.4	881.4	...	4.1	..

Southern Rhodesia Veterinary Report.

APRIL, 1939.

DISEASES.

No fresh outbreaks of scheduled diseases.

TUBERCULIN TEST.

Thirty-one bulls and five heifers were tested upon importation and there were no reactors.

MALLEIN TEST.

Eleven horses and twenty-six mules were tested upon importation and there were no reactors.

IMPORTATIONS.

From the United Kingdom.—Bulls 9.

From the Union of South Africa.—Bulls 22, heifers 5, horses 11, mules 26, sheep 778.

From Bechuanaland Protectorate.—Sheep 668.

EXPORTATIONS.

To the Union of South Africa.—Oxen 99, cows 3, horses 11.

To the Belgian Congo.—Sheep 65.

To Portuguese East Africa.—Oxen 153, cows 18.

To Northern Rhodesia.—Sheep 43, goats 1, pigs 1.

EXPORTATIONS—MISCELLANEOUS.

To the United Kingdom.—Chilled beef quarters, 4,175; frozen beef quarters, 86; frozen boneless beef quarters, 519; pancreas, 233 lbs.; tongues, 101 lbs.; tails, 179 lbs.

To Northern Rhodesia.—Nil.

To Belgian Congo.—Beef carcases, 117; mutton carcases, 24; offal, 548 lbs.

To Union of South Africa.—Corned beef, 60,504 lbs.; rolled beef, 180 lbs.

To Bechuanaland Protectorate.—Corned Beef, 984 lbs.

S. A. MYHILL,
Chief Veterinary Surgeon.

SOUTHERN RHODESIA

Locust Invasion, 1932-39.

Monthly Report No. 77. April, 1939.

The campaign against hoppers of the Red Locust (*Nomadacris septemfasciata*, Serv.) has come to an end in most districts during April, the surviving hoppers having matured.

No report of movements of winged swarms had been received, however, at the end of the month.

The campaign has been hampered by the exceptionally wet weather from December to March, but the damage to crops has not been generally serious, the destruction of twenty-three native gardens in one district constituting the most serious loss reported to date.

RUPERT W. JACK,
Chief Entomologist.

NOTICE

The Agricultural Journal of S. Rhodesia

is issued by the Department of Agriculture, and can be obtained upon application to the Editor. The Annual Subscription, which must be paid in advance, is 5/-, and payment may be made by any means other than by stamps.

A 10/- note will cover the subscription for two years.

Persons residing outside Southern and Northern Rhodesia may become subscribers by paying 2/- in addition to the subscription, to cover postage.

If payment is made by a cheque drawn on a bank outside Rhodesia, commission must be added.

All cheques and postal notes must be made payable to the Secretary for Agriculture and Lands.

Date..........................19....

To the Secretary,
Department of Agriculture and Lands,
Salisbury.

Please enrol me as a subscriber to the "Rhodesia Agricultural Journal" for one year from....................................

19......, *for which I enclose*..

Name....................................... ....

Full Postal Address.................................

....

....

Please write distinctly

S.E.S. Oats, grown by Mr. A. Stidolph, near Salisbury. Planted 30.12.38, reaped 18.5.39. Rainfall 36.89, total rainfall 55.89. This variety was bred at the Salisbury Experiment Station and produces heavy grain, and is particularly valuable for grazing and green soiling. Its straw is too coarse for oat forage.

THE RHODESIA

Agricultural Journal

Edited by the Director of Agriculture.

(Assisted by the Staff of the Agricultural Department).

PUBLISHED MONTHLY.

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VOL. XXXVI.] JULY, 1939. [No. 7

Editorial.

Contributions and correspondence regarding subjects affecting the farming industry of Southern Rhodesia are invited. All communications should be addressed to:—The Editor, Department of Agriculture, Salisbury. Correspondence regarding advertisements should be addressed:—The Art Printing Works, Ltd., Box 431, Salisbury.

Tobacco Pest Suppression Act, 1933.—Tobacco growers are reminded that, in terms of Section 10 of Government Notice No. 367, as amended, growers shall have caused to be uprooted and destroyed by the first day of August, all growing Virginia tobacco plants, including living stalks and roots, which have been growing on their premises. Similarly, Turkish tobacco must be removed and destroyed by 1st September.

The Eradication of Nut Grass.—Nut Grass is too well known to require any description. It is not a grass but a sedge and its scientific name is *Cyperus rotundus* L. The common name,

however, denotes the grass-like habit of the weed and the nut-like underground tubers. It is one of the most troublesome weeds and in some places it has become so plentiful that the cultivation of fields has been abondoned in despair. It is now common in most of the warmer parts of the world. It is said to have been introduced into South Africa by the Malays to provide a dense mat on the sandy Cape soils upon which washing could be spread in the sun to bleach and dry. The development of new underground tubers is so rapid that it is almost impossible to eradicate the plant when once established. The use of chemical weed-killers has not been successful.

A report on recent work carried out in the United States, however, indicates that it may be possible to clean small areas by cultivation. The following is the summary of a paper which appeared in the Journal of the American Society of Agronomy in January, 1938, by E. V. Smith and E. L. Mayton :—

"No plants occurred on plats which had been ploughed at 1- or approximately 3-week intervals. A total of eight plants developed on the plat ploughed at 4-week intervals and one plant on the plat ploughed every 2 weeks. This plant was carefully dug and found to arise from a tuber 12 inches below the soil surface. This tuber had apparently lain dormant in the soil for 2½ years. No plants were founds on the plats disced at intervals of 1, 2, or approximately 3 weeks On the plat disced every 4 weeks, a total of 150 plants was found on the two small areas. At the end of the season this plat carried a generally light infestation over its whole area."

July Cleanliness on the Farm.—Virginia tobacco lands should be clean by now, and are legally required to be clear of tobacco by the end of the month unless special exemption has been obtained. If grading has been completed, start in right away on cleaning and lime-washing the sheds, and burn all refuse. Remove all tobacco as early as possible, whether saleable or unsaleable.

Where practicable, remove old stored maize to tobacco curing barns, in order to clean up maize stores thoroughly and in plenty of time before the new crop is brought in.

Pigeon-hole stack the old maize and heat the barn for a day or two until the temperature inside the bags has been 125° F. for 24 hours, to kill weevil. When all old maize is consumed, heat up the barns again to 125° F. for 24 hours. Second-hand bags can be draped over poles in the barn and exposed to the heat. A thorough clean-up of maize refuse in the vicinity should be given at the same time. Weevil will not be eliminated but will be reduced.

Remove weeds and dry out the soil of eelworm-infested lands by frequent ploughing during the dry season. Plan for a weed-suppressing resistant crop to follow.

Cleanliness Aids Insect Control.

Trees and Wild Flowers.

ON THE RHODESIAN FARM.

By Chas. K. Brain, M.A., D.Sc., Director of Agriculture.

PART VII.

Mukwa. *Pterocarpus angolensis* D.C. Fam. *Leguminosae*. —This is one of our common trees which is fairly well known as Mukwa, Bloodwood or Sealing Wax Tree. Depending upon its age and the soil in which it is growing it is a small to medium-sized tree up to 60 feet high (Fig. 47). The trunk is usually straight and the bark rough and almost black in colour. Whenever the tree is cut or damaged the red sap exudes, which dries into a red mass, which accounts for the common names given to the tree. The leaves are unequally pinnate with five to seven pairs of leaflets. It flowers in October or November and the deep yellow pea-like flowers are in dense clusters, which appear before the new leaves expand. The yellow petals are crinkled. The pods are well known because of the wide membranous part surrounding the raised, densely bristly centre. Children say that the pods remind them of hedgehogs with life-belts on. (Fig. 47a.)

It occurs in pure forest belts on the Kalahari Sands north of Bulawayo and is found scattered throughout the sand-veld areas, particularly on stony hills. It is found growing to perfection between our Eastern Border and the Coast, and it has been suggested that this is the Almug tree mentioned in the Old Testament and that this part of Africa was indeed the source of supply of the wonderful trees mentioned in the First Book of Kings.

Muhatcha. *Parinarium mobola* Oliv. Fam. *Rosaceae*.— This when seen growing under favourable conditions is undoubtedly one of our finest native trees. Its dark ever-green crown provides shade throughout the year (Fig. 48).

Fig 47.—Mukwa growing on the Salisbury Commonage Tree in fruit with most of the leaves fallen May, 1939.

Fig. 47a.—Cluster of Mukwa seed pods after the leaflets have fallen

Fig. 48.—"Muhatcha." *Parinarium mobola* Oliv. Coming into flower on Salisbury Commonage at the end of September.

Fig. 48a.—"Muhatcha." Twig showing leaves and young fruit.

Fig. 49.—*Parinarium capense* Harv. A common plant on sandveld.

Fig. 50.—*Dichapetalum cymosum* Hook. A native plant which is very poisonous to stock at certain seasons of the year.

It is one of our few native trees which belong to the Rose Family. Wherever conditions for full growth are unsuitable, owing to soil, altitude, frost or veld-fires, this species, in common with many other natives trees, produces a shrub form which may only be a foot or two high. Under such conditions the underground parts are well developed, but the parts above ground are restricted in their growth. Muhatcha produces masses of small yellow flowers about October and the hard russet fruits take a long time to mature (Fig. 48a). When full grown and ripe the fruits are yellow and about the size of a small plum. They are collected and eaten by natives.

The scrub form of *Parinarium mobola* must not be confused with a different species which is common throughout the country, *viz.*, *Parinarium capense* Harv. (Fig. 49). In this the stems are never more than about six inches long; the leaves are longer and very white below and the plant makes a dense mat of leaves commonly found on sandveld. The fruit is something like that of *mobola* but more grey. Its common name in South Africa is "Grysappel." The leaves of *P. capense* have been sent to this office on several occasions to ascertain if they could have caused losses in cattle. Neither species of *Parinarium* possesses any poisonous properties, but the plant of which the description follows next in this series is of smilar habit to *P. capense* and is, at certain times of the year, very poisonous.

'Ncusane. *Dichapetalum cymosum* Hook. Fam. *Dichapetalaceae.*—This is a plant that is well known in the Transvaal by the name Gifblaar, *i.e.*, poison leaf. Its distribution in Southern Rhodesia seems to be restricted to the Lower Gwelo and the Nyamandhlovu districts, where it causes deaths in cattle every year. Although it only makes a growth of six or eight inches above the ground its branches and roots below ground are enormous and form really an underground tree, the leafy twigs of which are shown in Fig. 50. It will be noted that they are similar in form and size to those of *Parinarium capense*, but those of 'Ncusane are green and similar in texture on both surfaces and the side veins are not straight to the edge of the leaf but looped before they reach the margin.

Investigations carried out at Ondertepoort have shown that this plant is only really dangerous to livestock during two periods of the year when it puts on new growth. These vary slightly with the rainfall and general growing conditions, but the first is before the rains, *i.e.*, from the end of August until the end of October and the other from March to May. It is the common experience among stock owners that cattle which have eaten this plant, which most commonly happens before there is any green grass, frequently drop dead shortly after drinking water.

In this country the natives state that when cattle eat 'Ncusane they have a great thirst and die as soon as they drink. When found growing in the vicinity of a kraal it is said the natives dry the leaves, pound them up and mix the dust with the dregs of kaffir beer and water and give it to cattle to drink. They state that having taken the powdered leaves they will not touch the live plant again. Whether there is any truth in this or not it certainly appears that cattle brought up on veld where 'Ncusane grows apparently avoid it, while cattle freshly introduced into such areas often die as a result of eating it. As far as is known there is no satisfactory treatment for cattle which have eaten this plant in its poisonous stage.

Cleanliness Aids Insect Control.

Grass Fires and Fire-belt Burning.

By J. R. Perrins, P.B.S. Ranch, Fort Rixon.

The burning of fire breaks is one of the best safeguards against the spread of grass fires, both as a direct preventative of spread and as a means of burning back on to an advancing fire. A few notes therefore on methods of carrying out the operation may be of help to the newcomer, and even to those who have not hitherto adopted the precaution.

The practice is obviously very much facilitated or otherwise by the nature of the country through which the break is required and it is often not possible to burn along a boundary on account of its broken or hilly character. An intelligent survey of the country before operations commence will well repay the time and trouble involved.

Fire Breaks.—Where this means of preventing the encroachment of grass fires on one's property is adopted it is usual for some existing natural barrier to be employed either as the base of operations or to be strengthened and reinforced at intervals where the danger of a fire crossing may exist; such barriers are in order of usefulness: large rivers, main roads, by-roads, spruits, dongas, kaffir paths, etc.

Wet spruits are often possible of use, but in most cases have at intervals rank grass extending up to and overhanging the banks, which in itself is dangerous and difficult to handle when alight. These wet spruits, and rivers whose width does not make them an effective barrier, can often advantageously be used by early burning of the rank vegetation where the river is narrow and might be jumped by a wind-driven fire. Dry, sandy spruits or dongas can also be utilised to link up with artificially created fire breaks where their length and direction is adequate or suitable.

Where no natural base for the operations exists some form of artificial aid must be employed, among which one or other of the following may be found the better adapted to the nature of the country:—

Cutting a strip of grass with the mowing machine;

Ploughing a few furrows;

Dragging a bush or tree backwards and forwards to beat down the long grass and thus form a strip which will not burn very fiercely.

Although it is usual to create a single fire-belt by one or other of these means, two parallel ones can be made where extra precaution is required or where the available labour is inadequate to deal with an emergency, but the strip between the lines should be at least 30 yards wide; very tall and rank grass will require up to a 50 yard strip to ensure reasonable safety in stopping a wind-driven fire.

Where a single strip is used, when burning the break, the fire should be started along the edge of the strip on the side away from which any wind may be blowing so that the fire is burning back against the wind; lighting can be done along 50 to 100 yards at a time according to the labour available, and is done by means of wisps of dry grass, blow lamp or similar device. When the grass is lighted natives follow and beat out the fire on the side of the bare strip while on the other side of the fire is allowed to burn for some 5 to 10 feet in depth, after which it is safe to light the windward side of the break which in turn is beaten out once the fire is burning towards the inside. An adequate force of labour must be ready to beat out the outsides of the breaks shortly after they are lighted and at least two natives should follow up well in the rear of the burning to ensure that logs, cow dung or bushes do not cause the fire to spring up again and get out of hand before help arrives.

The burning of fire breaks should never be attempted in a high or even moderate wind, and the safest time for the operation, under the best conditions for securing a clean burn, is from 5 o'clock in the afternoon onwards, with a light breeze blowing. Operations should be suspended for the day when

dew begins to fall, and the grass becomes difficult to light and ceases to burn cleanly.

Heavily leaved bushes or branches are the most common and economical means of beating out fires, but they do not last long and one or two boys with axes are necessary to keep up a constant supply of fresh material for the fighters. In open country, or even in bush, the water-soaked old sack is the most durable and efficient, always provided that a supply of water is available for re-soaking at frequent intervals. As, however, the necessary surface water is seldom available in the near vicinity of a fire the usefulness of this "beater" is somewhat restricted, but it is often possible to take sufficient water in a lorry or vanette, carried in drums which can be quickly replenished, without taking the fire-fighters away from their work.

While the burning of fire breaks should not be left until the grass is bone dry, care must be taken that it is not done too early, as even a small growth of young grass springing up subsequent to the burning and later killed by frost will constitute a danger of the flames being carried over the "break" in hot weather with a wind behind.

Even where adequate fire breaks exist it is wise, in case of a fire, to keep a strict watch on them, since whirlwinds caused by the heat will often carry burning fragments over the widest break, and a heavy direct wind will blow burning pieces of grass for a considerable distance.

The safest way of utilising a fire-belt for checking a fire is to light the edge of the break in both directions starting from a point which it is thought the fire will first reach. This fire will then burn back on to the on-coming one and as they get nearer they will form a vacuum between them and draw the flames together in spite of wind, and to the exclusion of any danger.

The burning of fire breaks is a tedious and slow job, often entailing long walks to and fro and expert supervision, sometimes extending far into the night, but security from the grass fire menace can only be attained by these sacrifices of time, comfort and labour, and where the area is not unreasonably large the benefits and the security to stock and other property which result are undoubtedly worth the trouble and expense.

Salisbury Experiment Station

ANNUAL REPORT ON EXPERIMENTS, SEASON 1937-38

By H. C. Arnold, Manager.

The total rainfall for the season was 29.47 inches. The season opened late, with scanty showers and the stands of the early sown crops suffered somewhat in consequence. Soon after the rains commenced precipitation occurred almost daily during the months of December and January, but later droughty conditions prevailed again and the crops were adversely affected through lack of moisture at the end of the season.

Analysis of Rainfall: Season 1937-38.

Month.	No. of rain days.	Total for the month.	No. of rains over ¼ inch.	Total to end of month.	Periods exceeding one week without rain.
October	Nil	Nil	Nil	Nil	
November ...	8	1.72	3	1.72	Nov. 26th
December ...	18	7.46	10	9.18	Dec. 11th
January	30	13.09	18	22.27	Nil
February... ...	8	2.01	3	24.28	Feb. 1st to 22nd
March...	9	4.26	5	28.54	Mar. 14th to 25th
April	4	.93	2	29.47	Apr. 6th to Apr. 24th
	77	29.47	41		
Average for previous 10 years	72.4	28.63	35.1		

Although the total rainfall exceeded the average of the previous ten years, nearly two-thirds of it fell in the six weeks period, December 15th to January 29th. It is thought that this uneven distribution caused the crops to be lighter than the average.

The results of experiments conducted at this Station since 1919-20 are available in Bulletin form, and to facilitate comparison, this report is drawn up on lines similar to previous ones.

Having served their purpose the following experiments were discontinued:—

(1) Sunnhemp burnt versus sunnhemp ploughed under for green manure.

(2) Witchweed host crops versus sunnhemp for green manure.

(3) Once ploughing versus twice ploughing of green-manured land.

(4) Effect of various crops on the ground-nut crop which follows.

The series of experiments in which various methods of utilising the sunnhemp crop for the restoration of soil fertility are being compared, was extended to include the following treatments: (1) Ploughing under the sunnhemp at fourteen weeks after sowing the seed versus ploughing it under four weeks later. (2) Ploughing under the stubble immediately after removing the green top growth versus leaving the stubble unploughed until the winter ploughing season.

CROP ROTATION EXPERIMENTS.
FIRST SERIES 1913-1937.
Maize Yields in Bags per Acre.

System of Cropping.	1937-38 Rainfall 29.47	1936-37 Rainfall 32.68	1935-36 Rainfall 24.01	1934-35 Rainfall 31.07	1933-34 Rainfall 31.54	1932-33 Rainfall 27.64	1931-32 Rainfall 26.62	Average Yield.
*A1—Maize continuous. Green manure and 250 lbs. per acre of phosphatic fertiliser in the seasons 1928-29, 1932-33 & 1935-36	10.53	16.10	Green-manure ploughed under.	4.99	19.04	Green-manure ploughed under.	9.60	12.68 (7 crops)
*A2—Maize continuous. Fertiliser only, rates as above.	5.49	9.10	6.12	2.01	8.74	3.53	10.92	6.65 (10 crops)
†B—Alternate maize and beans for hay; no manure or fertiliser.	8.36	5.60	11.70	4.45	6.60	2.34	10.02	9.12
C — Three-course rotation: Maize, velvet beans (reaped), oats; no manure or fertiliser.	9.83	5.80	13.25	5.82	10.75	4.90	11.10	12.95
D — Four-course rotation: Maize (plus 6 tons dung per acre), oats, bean hay, maize. Average of two plots.	11.69	14 30	14.82	6.81	14.70	14.21	16.33	(22 years)
Maize (no manure direct).	9.78	14.70	16.63	6.82	11.90	14.40	14.80	16.53
Maize (dunged plots).	13.60	13.90	13.00	6.80	17.50	14.02	17.85	16.68

*NOTE.—Having grown maize for 15 years in succession without manure or fertiliser, during which time its yields had gradually decreased until they had become so low as under practical field conditions to have rendered them negligible, this plot had served its purpose. With the object of comparing two methods of again raising the cropping power of such land to a more profitable standard, the whole plot was treated with a mixture of one-third bone meal and two-thirds superphosphate at the rate of 250 lbs. per acre, at the beginning of 1928-29. One-half of the plot was then planted to maize while the other half was sown to a mixture of sunnhemp and velvet beans, which were subsequently ploughed in. This manurial treatment was repeated on the respective plots during the seasons 1932-33 and 1935-36.

†In 1929-30 this system was amended from "Alternate Maize and Bare Summer Fallow" to "Alternate Maize and Beans for Hay."

System A.—The green-manured plot has maintained its lead over the one which receives no humus, with a yield nearly twice as large as the latter's. The average annual yields on Section A1 and A2 may be compared as under, where the yields during the periods following each application of green manure are summed and averaged.

Average Yields in Bags per Acre per annum.

Period.	1929 to 1932.	1933 to 1935.	1936 to 1938.	Total yield 1929 to 1938.
Section A1	9.52	8.01	8.88	88.74
Section A2	7.89	4.76	6.90	66.54
Difference	1.63	3.25	1.98	22.20

These show that on Section A2, where the soil lacks humus, the yields were more severely affected than they were on the green-manured land during the period 1933-35 when unfavourable seasons were encountered, and it would seem that, although Section A1 has yielded 22.20 bags per acre more than Section A2, its cropping power, owing to the green manure which is periodically ploughed in, is being maintained better than it is on the land which receives no humus dressing, in spite of the larger toll on the plant nutrients of the soil which the heavier crop takes.

System B.—The results obtained from these plots support those of System A. In the season 1929-30 the system of cropping was changed from "bare fallow" to "beans for hay," in alternation with maize. Dolichos beans were sown, but they did not thrive well and in the season 1933-4 they were replaced by Soya beans interplanted with velvet beans. Since that time heavier crops of both beans and maize have been reaped from these plots. The yields of maize reaped from this unfertilised land may be compared with those taken from Section A2 which receives phosphatic fertiliser but carries maize continuously. Before the season 1933-34 the maize yields on the fertilised land were heavier than those of the land which produced a light leguminous hay crop, but since the change to the thrifty Soya plus velvet bean hay crop was made four years ago, the maize yields have increased;

the average being nearly two bags per acre in favour of the land which produces the legume hay.

System C.—When it is remembered that this land has been cropped for 25 years and during that time it has not received any manure or fertiliser, but has yielded a crop every year, it will be seen that its yields of maize are remarkably high. Comparison with System A1, where the land receives green manure and fertiliser, shows that the total yields of maize during the period 1932-38 are approximately equal, namely, System A1 60.26 bags and System C 61.45 bags. This indicates that the farmer who can make good use of the side crops on his farm will find a mixed cropping system more profitable than growing maize alone.

System D.—This system simulates the conditions which would be found in practice, more accurately than System C, because it includes a dressing of humus in the form of kraal manure as well as a diversified system of cropping. The yields obtained are seen to be higher than those of the other systems. The yields of the oat and bean crops (not shown) are also much larger than those in the other system.

The stabilising effect of mixed cropping is well shown by the maize yields recorded each year. These show that the maize crops in this rotation are much less subject to the vagaries of the weather than are those in the single crop systems.

SECOND SERIES OF CROP ROTATIONS.

These rotations were laid down in 1919-20 and were designed to evolve a system of cropping which would meet the needs of farmers who could not adopt mixed farming. The series included two plots, A. and F., on which maize was grown continuously for ten years without manure or fertiliser to serve as checks on the results from the rotations. For this purpose the cropping of Plot A. continues as in the past, but on Plot F. commencing season 1929-30, fertiliser is applied in alternate years. The fertiliser treatment given to this plot is the same in quantity and quality as that accorded in rotational System H., but green-manuring is entirely omitted.

Plot A: System E.—Maize continuous without manure or fertiliser.

Seasons and Yields of Maize in Bags per Acre.

1937-38.	1936-37.	1935-36.	1934-35.	1933-34.	1932-33.	1931-32.	Average over 19 years.
3.89	3.80	6.88	2.21	4.60	1.74	11.60	9.30

Owing to the careful cultivation given to these experiment plots, it is reasonable to think that the yields recorded are somewhat higher than would be obtained from similarly cropped land under field conditions. It will be seen, therefore, that the cropping ability of this land has now declined to such a low level that in practice its cultivation would not yield a profitable return to the farmer.

Plots B to E: System F.—Three-quarters of the land under maize, one quarter under Sudan grass. Each year one section under maize, commencing with Plot B in 1919-20, receives eight tons of farm manure per acre, and commencing on Plot E in 1929-30, the section which grew Sudan grass the previous season receives 200 lbs. per acre of superphosphate (19 per cent. P_2O_5).

Maize Yields in Bags per Acre.

	1937-38	1936-37	1935-36	1934-35	1933-34	1919-20	Average 1920-38
Plot B ...	Sudan	11.50	19.55*	7.19†	Sudan	26.0	16.75
Plot C . .	11.74	14.75*	15.93†	Sudan	15.45	23.7	15.09
Plot D ...	12.64*	15.25†	Sudan	6.05	18.80*	Sudan	15.49
Plot E ...	10.69†	Sudan	16.68	6.99*	17.73†	24.6	15.61
Average...	11.69	13.83	17.39	6.74	17.33	24.7	15.74

*Indicates the application of farmyard manure.

†Indicates the application of 200 lbs. per acre superphosphate.

In common with the other systems, the yields obtained in System F this season are somewhat below those of the past two seasons. This indicates that the weather conditions experienced were somewhat less favourable than those of the previous years rather than a definite decline in the fertility of the land. It also shows, however, that the amounts of manure and fertiliser used are not sufficient to increase the

cropping power of the land, and they should be regarded as the minimum required for a system in which the land is almost continuously cropped to maize.

Plot F: System G.—Maize continuous. No manure or fertiliser during the first ten years. Commencing season 1929-30, fertiliser consisting of one-third bone meal and two-thirds superphosphate at the rate of 200 lbs. per acre is applied every alternate year.

Seasons and Yields of Maize in Bags per Acre.

1937-38.	1936-37.	1935-36.	1934-35.	1933-34.	1932-33.	1919-20.	Average over 19 years.
7.79*	6.65	15.26*	3.70	14.55*	5.33	23.3	11.09

*Indicates the application of 200 lbs. per acre fertiliser.

In previous years the application of fertiliser has chanced to occur when favourable climatic conditions prevailed and heavy yields of maize resulted, but in the season under review the effect of the fertiliser dressing has been less marked. Although this land receives as much fertiliser as is supplied to the plots in System H, the yield is lower than that recorded for any of the plots in that system, and much lower than the average of the three plots. The absence of humus in this soil is thus seen to be limiting its productivity.

Plots G to K: System H.—Three-quarters of the land under maize, one-quarter under velvet beans, which are ploughed under for green manure. From the commencement of this experiment until 1928-29 this land received one green manuring and one application of fertiliser during each period of four years. The returns from these plots showed that insufficient plant food had been supplied to maintain fertility, and the manurial system was then amended to provide for two dressings of fertiliser during each four-year period. The crop of maize which follows the green manuring now receives 200 lbs. of 19 per cent. superphosphate per acre, which should enable it to make better use of the nitrogen supplied by the green manure; the second maize crop receives no fertiliser,

and the third crop, that immediately in front of the green crop, receives 200 lbs. per acre of a mixture of bone meal and superphosphate.

Maize Yields in Bags per Acre.

	1937-38	1936-37	1935-36	1934-35	1933-34	1919-20	Average 1920-38
Plot G . .	Beans	11.20†	14.78	14.58*	Beans	23.10*	14.51
Plot H ...	8.40*	9.90	20.28*	Beans	14.50*	23.00	14.99
Plot J .	9.86	20.56*	Beans	4.34	12.25	Beans	13.80
Plot K ...	18.18*	Beans	15.35*	3.59	19.65*	19.20	14.56
Average	12.15	13.89	16.80	7.50	15.47	21.70	14.47

*Denotes application of fertiliser.

The average yield for the season under review is seen to be 2.32 bags per acre less than that of the average for the past 18 years, while in System F the yield is 4.05 bags per acre below the eighteen-year average. For several years the yields in System F were higher than those of System H, but it now appears that the manurial applications employed in the latter system are more effective than those of the former in maintaining the cropping ability of the land.

THIRD SERIES OF CROP ROTATIONS.

In the season 1926 27 two more rotational systems were laid down, which have been designated Systems M and O respectively.

System M.—This is a four-course rotation in which the sequence of the crops is:—Maize+200 lbs. per acre of superphosphate; ground nuts and sunflowers; maize+200 lbs. per acre of bone and superphosphate; green manure. Hence one-half of the land is sown to maize, one-eight to sunflowers and another eighth to ground nuts, and one-quarter is green-manured. In the following tabulation the yields of the various plots are expressed in bags per acre, a "bag" of maize being 200 lbs., and a "bag" of ground nuts 65 lbs.

Seasons and Yields of Maize in Bags per Acre.

	1937-38	1936-37	1935-36	1934-35	1933-34	1932-33	1926-7	Average maize yield 1926-38
Plot A... ...	9.66*	N14.3	14.90*	G.M.	13 75*	N14.00	G.M.	12.55
Plot B... ...	N17.9	15.72*	G.M.	5.55*	N14.30	10.15	15.15*	11.72
Plot C... ...	11.48*	G.M.	12.50*	N8.8	12.60	G.M.	N21.0	13.10
Plot D... ...	G.M.	14.88*	N15.70	7.95*	G.M.	8.05*	12.06	11.74
Average maize yield	10.57	15.30	13.70	6.75	13.17	9.10	13.88	12.38

*Denotes the application of fertiliser.

G.M. Denotes the application of green manure.

N. Denotes the position of the ground nuts in the rotation.

In view of the high yields reaped in this rotation last season those obtained this season are disappointing. There were indications during the growing season that some factor other than those of the planned treatments was adversely effecting the thriftiness of the maize plants on Plot A. A higher yield from the green-manured plot could have been expected also, because the fertiliser treatments in this system is similar to that of System H, where the yield of maize following the application of green-manure is 58% higher.

System O.—The order of rotation is:—Maize fertilised with 200 lbs. per acre of bone and superphosphate; sweet potatoes; maize which receives a dressing of 8 tons per acre of farmyard manure; hay crops. This system is typical of a rotation suitable for dairymen or others who prefer to feed a large proportion of their crops to livestock. In practice it would probably be found necessary to make alterations to meet individual requirements, such as altering the proportion of maize to other crops; leaving the sweet potatoes down for two years, or reducing the amount of land under sweet potatoes, and growing pumpkins and melons instead. Whatever the details of the adopted system may be, if the principles on which this rotation is based are adhered to, similar results could be expected.

In the tabulation below are shown the acre-yields of maize in bags of 200 lbs. and of bean hay and sweet potatoes in tons.

Seasons and Yields in Bags (or Tons) per Acre.

	1937-38	1936-37	1935-36	1934-35	1933-34	1926-27	Average maize yield 1926-38
Plot F	12.03†	P 1.02	19.32*	H 3.8	19.18†	H 1.1	16.86
Plot G	P 1.35	15.61*	H 1.4	11.58†	P 5.5	19.65	15.17
Plot H .. .	11.73*	H 2.29	17.78†	P 5.65	20.80*	P 6.1	17.15
Plot J	H 1.32	14.85†	P 3.70	9.84*	H 2.5	16.45*	13.65
Average of maize plots	11.88	15.23	18.55	10.71	19.99	18.05	15.71

*Denotes the application of fertiliser.
†Denotes the application of farmyard manure.
P Denotes the position of the sweet potatoes in the rotation.
H Denotes the position of the bean hay crop.

The manurial treatment of this land is about the same in quality and quantity of that provided in System F, and the average maize yield is practically the same in the two systems. This season's maize yield is 3.83 bags per acre less than the average yield for the period 1926-38, which is about the same as the decrease noted in System F. In System M the decrease is only 1.81 in the same comparison, and this is about the same as that noted for System H. It is seen therefore that in both of the systems in which 8 tons of farmyard manure and 200 lbs. of phosphatic fertiliser form the manurial treatment there is a larger decline in the maize yields than in the other systems which receive green-manure and 400 lbs. of phosphatic fertiliser during each four-year period. The two manurial systems supply approximately the same amount of phosphate and the farmyard manure supplies small amounts of potash, lime, etc., which are not added by the green manure, so that the odds would seem to be in favour of the farmyard manurial system. Although it is as yet too early to deduce that the cropping ability of the green-manured land is being better maintained than that of the other system, the results of this season's trials indicate such a tendency.

Methods of Utilising the Sunnhemp Crop for the Restoration of Soil Fertility.—These trials were commenced in the season 1935-36, when sunnhemp was sown and treated in different ways. The plots were all sown to maize last season and the results were published in last year's report on Experiments.

Instead of cropping with maize again, during the season under review it was decided to amend the plan of treatments so that they are now as follows:—

(*a*) Sunnhemp for green manure ploughed under in the usual way eighteen weeks after the germination of the seed.

(*b*) Top growth of sunnhemp crop cut off eighteen weeks after germination, composted and returned again to the same plots.

(*c*) Top growth of sunnhemp cut for hay. Stubble only ploughed under during the autumn months.

(*d*) Top growth of sunnhemp cut off, composted and applied to the (*e*) plots, which carry maize instead of the green-manure crop. Stubble only of 18 weeks old crop ploughed under.

(*e*) Maize continuously; land receives application of compost made from the top growth of the green-manure crop on the (*d*) plots.

(*f*) Maize continuously without humus dressing.

The above treatments are replicated 10 times and each of the sixty plots in the experiment will be divided into two; on one half raw rock phosphate at the rate of 200 lbs. per acre will be applied and no fertiliser will be used on the other half. The whole area will be sown to maize during the season 1938-39.

The Effect of the Date of Ploughing under of a Green Crop on the Yield of the following Maize Crop.—These experiments were commenced in November, 1935, and the results of the first series were published in the *Agricultural Journal* for October, 1937. Sowings of sunnhemp in the second series commenced in November, 1936, and were continued at fortnightly intervals until January, 1937. In each case the green crops were ploughed under fourteen weeks after the germination of the seed. Each treatment was replicated eight times, so that eight plots of sunnhemp were ploughed under at each fortnightly period. In November, 1937, all the plots were sown to maize on the same day.

Dates of sowing Sunnhemp.	Dates of Ploughing Sunnhemp.	Yields of Maize following Sunnhemp in bags, per acre. Season	Percentage increases in yield of Maize due to later date of ploughing in Sunnhemp. Season	
Season 1935-36.		1936-37.	1936-37.	1935-36
Nov. 15th	Feb. 21st	11.65	100	100
Dec. 1st	Mar. 7th	12.83	110	108
Dec. 15th	Mar. 21st	14.30	123	118
Dec. 31st	Apr. 6th	14.23	122	123
Jan. 15th	Apr. 21st	13.50	116	125

This season's experiments support those of the previous year by showing that the maximum beneficial effect of the green manure crop will not accure if it is ploughed under before the middle of the month of March..

Rates of Seeding Sunnhemp and Methods of Treating the Top Growth.—In the season 1936-37 sunnhemp was seeded at various rates, *viz.*, 20 lbs., 40 lbs., 60 lbs. and 80 lbs. per acre on plots which were replicated five times. These plots were each divided into four sub-plots and the sunnhemp was treated in the following ways:—

(*a*) whole growth ploughed under in the usual way at 16 weeks after seeding;

(*b*) top-growth cut off 16 weeks after seeding and stubble; ploughed under immediately;

(*c*) top growth cut off as in (*b*) and the stubble ploughed under as in (*d*);

(*d*) crop matured; top-growth taken off and stubble ploughed under during the winter months.

During the season under review the whole area was sown to maize, the yields of which showed no significant difference as a result of the various rates of seeding, but the differences resulting from the other treatments were as shown below, where the average yields of the twenty plots under each treatment are given.

Yield of Maize in Bags per Acre.

Whole crop ploughed under March 25th.	Immature Stubble. Top growth cut March 25th. p.u. March 25th.	Immature Stubble. Top growth cut March 25th. p.u. July.	Mature Stubble p.u. July.	Standard Error.
18.17	16.82	16.79	18.15	0.20

A difference between treatments of three times the standard error or 0.60 bag of maize per acre may be taken as significant.

The similarity in the yield obtained from the land on which the mature stubble was ploughed under and that on which the whole crop was ploughed under is remarkable. Both these treatments have yielded approximately $1\frac{1}{3}$ bags more than the land on which the immature top growth was cut off and removed instead of ploughing it under. In these trials no advantage was gained by delaying the ploughing under of the immature stubble, and it is considered that this is due to the fact that the stubble was ploughed late in March after 10 days' drought, and that very little rain fell subsequently to activate nitrification of the stubble ploughed on March 25th. The results indicate that a more mature stubble of sunnhemp has greater manurial value than one which is less mature.

Double Ploughing versus Single Ploughing of Green-manured Land.—In general practice when a green crop is ploughed under the material is left in masses under the soil, and it might reasonably be assumed that if the stuff was more thoroughly incorporated with the soil greater beneficial effects would accrue to the crop which follows. Experiments have been conducted during the past three seasons to ascertain what the effect might be.

Each season an area of green-manured land was divided into six plots; these were sub-divided and one half of each plot was twice ploughed while the other half received the initial ploughing only. The first ploughing took place during the end of March or early in April, and the second in the month of November of the same year. In the tabulation which follows the yields of maize from each pair of plots is given in lbs. per plot.

Season 1935-36. Ploughed Once.	Season 1935-36. Ploughed Twice.	Season 1936-37. Ploughed Once.	Season 1936-37. Ploughed Twice.	Season 1937-38. Ploughed Once.	Season 1937-38. Ploughed Twice.
84	68	90	109	83	57
84	110	86	101	75	89
106	97	91	118	91	71
113	97	108	95	98	75
104	105	95	98	90	98
117	98	102	98	99	99
608	575	572	619	536	489

In these trials the total yield from the plots where the land was once ploughed were slightly heavier than that of the plots which were twice ploughed, but comparison of the yields within each pair of plots shows that the differences recorded are not due to the treatment under consideration, but that they are due to other causes.

Ground Nuts following various other Crops for comparison of the effect of the previous Crop on the yield of Nuts.—The crops used in these trials were as follows:—Maize (grain), sunflower (seed), oats (hay), velvet beans (mature crop reaped), sunnhemp (mature crop reaped), sunnhemp (whole crop ploughed under). The plots of these were replicated five times. Ground nuts were sown on the land during the season following that in which the crops were grown. In the following tabulation the yields of nuts reaped during three separate seasons are shown under the names of the crops which preceded them.

Yields of Ground Nuts in lbs. per Plot of 1/30 *Acre.*

Years. / Crops.	Sunnhemp. ploughed in. 1935.	1937.	1938.	Sunnhemp. reaped. 1935.	1937.	1938.	Maize. 1935.	1937.	1938.
	49	28	42	58	32	52	65	36	48
Plot	52	40	48	56	45	50	63	36	47
Yields	46	63	52	58	71	49	64	63	45
	50	88	37	77	74	39	61	71	33
	48	37	30	63	38	35	58	55	32
Totals	245	256	209	312	260	225	311	261	205
Bags (65lbs.) per acre		21.9			24.5			23.9	
Percentage increase over sunnhemp p.u.					12.25%			9.4%	

Crops. Years.	Sunflower. 1935.	1937.	1938.	Velvet Beans. 1935.	1937.	1938.	Oats. 1935.	1937.	1938.
	70	45	51	67	28	49	68	39	55
Plot	68	38	54	63	31	46	70	37	51
Yields	60	75	50	70	63	48	57	70	43
	53	76	33	51	72	33	48	65	33
	74	74	36	62	52	33	60	72	37
Totals	325	308	224	313	246	209	303	283	219
Bags (65lbs.) per acre	26.4			23.6			24.8		
Percentage increase over sunnhemp p.u.	20.7%			8.2%			13.4%		

It is remarkable that the lowest yields were obtained from the land which was green-manured during the previous season. Hence it would appear that such treatment does not benefit this crop and it would be found more economical to grow cereal crops on green-manured land. The land which carried sunflowers in the previous season yielded 20% more nuts than the green-manured land, and it would appear that this crop had a definitely beneficial effect on the nut crop which followed. Statistical analysis of these results showed that the increased yields of the land under sunflower, oats and sunnhemp reaped are significantly greater than that of the land where sunnhemp was ploughed under, but that the increases recorded after the maize and velvet beans may possibly be due to chance. These trials show that the response of the ground nut crop to soil treatment is very different from that of maize, which usually greatly benefits from the ploughing under of a green crop and also from the effect which a legume exerts on the soil even when the whole top growth is removed.

It has been proved that the presence of much nitrate in the soil during the early stages of growth of a legume tend to prevent the nodule bacteria from infecting the roots of legumes, and it seems probable that this is the explanation of the inferior yields of the ground nuts when following a crop of sunnhemp ploughed under.

Horse Gram (*Dolichos biflorus*) **for Hay Production.**—Trials were laid down during the season under review to ascertain the value of this crop for hay production. It was grown by itself and in mixture with other suitable crops, and these were compared with Biltan Soya beans sown alone. The plan was as follows:—(*a*) Dolichos biflorus alone; (*b*) Dolichos with manna; (*c*) Dolichos with S.E.S. oats; (*d*) Dolichos with sunnhemp; (*e*) Dolichos with Soya bean; (*f*) Soya beans only. Each crop or mixture of crops was sown in eight blocks of randomised plots during the early part of December. Owing to its procumbent habit and its much branched stems the dolichos biflorus made a dense mat of growth which covered the whole surface of the soil, and the reaping of the crop proved somewhat tedious. In the crop mixtures the dolichos climbed up the stems of its partner and the combined crops, being erect, were not difficulty to reap. Single-stemmed crops such as the oats, manna and sunnhemp, were more suitable for mixing with the dolichos than soya beans, because the beans cast too much shade. If soya beans are used they should be sparsely sown. Sunnhemp was not very suitable because it reached the stage for cutting much earlier than the dolichos. The following yields were recorded.

Yields of Hay in lbs. per Acre.

Dolichos biflorus only.	Dolichos and Oats.	Dolichos and Soya Beans.	Dolichos and Manna.	Dolichos and Sunnhemp.	Soya Beans only.
3,372	6,849	4,119	3,246	3,123	3,944

The dolichos and S.E.S. oats seemed to make the best mixture because they developed evenly and both arrived at the right stage for cutting at the same time.

Protein Production Crops.—When the "Somerset" variety of sunnhemp was introduced a few years ago it was soon realised that its free-seeding ability made it a suitable crop for hay, and the question arose as to how it compared with other fodder crops in its ability to produce fodder. It is well known that the most valuable part of fodders which are used as cattle food are the proteins, and that being so, the crop which produces the most protein per acre would appear to be the most economical, provided it is palatable to the stock

and can be produced economically. Trials were laid down in the season 1935-36 which included the following crops:—Somerset sunnhemp, Biltan soya bean, Somerset velvet beans, maize and wintersome. The results of the first two years' trials were published in the September, 1938, issue of this Journal. During the season under review the trials were extended to include maize as grain, velvet bean as silage, sunnhemp cut when 11 weeks old, sunnhemp cut when 14 weeks old. The plan provided for six replicated plots for each crop.

Yields of Crude Proteins in lbs. per Acre.

Season.	Somerset sunnhemp cut at 11 weeks.	Somerset sunnhemp cut at 14 weeks.	Somerset Velvet Bean Hay.	Somerset Velvet Bean Silage.	Biltan Soya Bean Hay.	Maize—Cut for Silage.	Maize—Mature Crop.	Wintersome Silage.
1935-36	435	—	—	869	419	296	—	364
1936-37	270	—	—	468	311	177	—	249
1937-38	256	248	820	805	594	312	377	248
Averages . .	320	248	820	714	441	262	377	287

These results show that the amount of protein in the 14-weeks' old sunnhemp crop was no larger than that in the 11-weeks' old crop, although it was somewhat heavier in total weight. The figures given for the mature maize crop includes 80 lbs. of protein contained in the stalks. The yield of grain was 16 bags per acre. The velvet bean has proved to be the most efficient crop for protein production, but in farm practice it is found to be not entirely suitable for hay. Its numerous fleshy pods are a disadvantage, since they require such a long period to cure that much of the leafy and most valuable portion of the crop may be lost during the hay making period. The problem of ridding the hay crop of fleshy pods can be solved by planting late, but when this is resorted to a rather smaller crop results. The use of tripods for making velvet bean hay solves most of the difficulties, such as loss of leaf in handling, and allows the crop to be left for a long period in the field to allow the pods to dry out if necessary, since once it is on the tripods it is safe from damage by late rains.

The latter fact has been well demonstrated at the newly-opened witchweed demonstration farm this year, where velvet bean hay on tripods withstood three inches of rain which fell in heavy storms without damage.

Pastures.—During the season under review a deviation from the practice of previous years was made in that the pasture paddocks were not grazed during the summer season. The reason for this was to ascertain what effect (if any) the phosphatic fertiliser dressing, applied in the previous year, would have on the growth of grass, particularly as there had been no visible beneficial effect during the year it was applied. The dressings consisted of:—

(*a*) 200 lbs. superphosphate per acre.

(*b*) 200 lbs. rock phosphate.

(*c*) 400 lbs. rock phosphate.

(*d*) No fertiliser.

They were applied in 4 x 4 Latin squares to

(1) Woolly Finger grass.

(2) Hunyani grass.

(3) Creeping False Paspalum.

(4) Reed Timtohy.

(5) Mixed creeping grasses.

There were, in all, 20 replications of each fertiliser treatment. In the season under review a top-dressing of sulphate of ammonia was applied in December at the rate of 100 lbs. per acre, on certain of the blocks of phosphated plots, but not on others. The sulphate of ammonia treatment proved very effective, but no increased yield was obtained from any of the phosphate dressings. The yields and statistical analysis are shown in Appendix A.

The Woolly Finger plots received the phosphate dressing and sulphate of ammonia was applied to all of the plots. In this case also the phosphate dressings have not produced any increase in the yield. See Appendix B.

In the season 1936-37 applications of various quantities of rock phosphate were made to land on which it was proposed to establish Peddie finger grass, and the phosphate was ploughed in. The finger grass was planted, but a volunteer crop of *Urochlon mosambicensis* also appeared and both were allowed to grow together. In this case the phosphated plots yielded significantly larger amounts of fodder than those plots which received no phosphate. (Details in Appendix C.) The increased yield (average of the phosphated plots) is 1¼ tons of green fodder, or about ½ ton of hay per acre.

A small paddock was planted to Kafue Rhodes grass in the season 1935-36. Before planting the grass roots, applications of superphosphate were made as follows:—

(*a*) 200 lbs. per acre.

(*b*) 400 lbs. per acre.

(*c*) 800 lbs. per acre.

Four replications of each dressing being laid down and the fertiliser was ploughed in. Very heavy crops were obtained in the season 1936-37, viz., 2½ tons of hay per acre and 84 days' grazing on the aftermath. Cuttings of hay were made on these plots during the season under review. Although there was no difference between the yields obtained from the various dressings of phosphate, the yields of 1½ to 2 tons of hay were satisfactory and indicate that the phosphate had a beneficial effect.

APPENDIX A.

Application of Phosphates and Nitrogen to Grasses.

Treatments.

A=200 lbs. superphosphate +100 lbs. S/A.	B=200 lbs. superphosphate.
C=200 lbs. rock phosphate +100 lbs. S/A.	D=200 lbs. rock phosphate.
E=400 lbs. rock phosphate +100 lbs. S/A.	F=400 lbs. rock phosphate.
G=100 lbs. S/A.	H=No fertiliser.

Grass Yields.

Block.	A	B	C	D	E	F	G	H	Total.
(1) Hunyani grass	43.8	36.4	52.0	28.5	44.5	29.5	43.3	20.0	298.0
(2) Reed Timothy	49.5	5.8	52.7	11.8	48.5	8.3	46.7	8.3	231.6
(3) Mixed Creeping grasses	27.4	15.5	26.7	16.3	23.8	10.0	26.7	15.0	161.4
Total	120.7	57.7	131.4	56.6	116.8	47.8	116.7	43.3	691.0

Analysis of Variance.

Due to	Sum of Squares.	Degrees of Freedom.	Variance.	½ Loge Variance.
Total	5635.3	23	—	—
Blocks	1166.7	2	583.4	—
Treatment	3367.7	7	481.1	3.08806
Error	1100.9	14	78.6	2.18220

Calculated value of Z=.90586.

*Observed value of Z =.5233.

Therefore treatment differences are significant.

A	B	C	D	E	F	G	H	Mean	Standard Error.
120.7	57.7	131.4	56.6	116.8	47.8	116.7	43.3	86.4	15.3

Conclusions.—Differences 3 times the Standard error (or 45.9) may be reckoned as significant.

Therefore A, C, E and G are all significantly better than B, D, F and H.

The nitrogen has had a significant effect on the yield of grass, but not the phosphate. The average increase due to the application of 100 lbs. sulphate of ammonia was 4,670 lbs. of green grass per acre.

APPENDIX B.

Application of Phosphates to Woolly Finger Grass.

(Block 48).

Yield in lbs. per Plot.

	ROWS.				Totals of Rows.	Totals of Treatments.
Columns	C. 57.3	D. 38.3	A. 41.0	B. 34.8	171.4	A=151.8
	A. 37.5	B. 29.3	C. 39.0	D. 30.3	136.1	B=139.7
	D. 28.0	C. 25.0	B. 29.3	A. 33.5	115.8	C=162.6
	B. 46.3	A. 39.8	D. 38.3	C. 41.3	165.7	D=134.9
Totals of Columns	169.1	132.4	147.6	139.9	Grand total	=589.0

Analysis of Variance.

Due to	Sum of Squares.	Degrees of Freedom.	Variance.	½ Loge Variance.
Total	953.54	15	—	—
Rows	509.27	3	169.76	—
Columns...	188.03	3	62.68	—
Treatments	116.47	3	38.82	1.82948
Error	139.77	6	23.30	1.57424

Calculated value of Z=1.82948—1.57424=.25524

*Observed value of Z = =.7798

Conclusions. — Treatment differences not significant. Application of phosphates to Woolly Finger grass has had no significant effect.

A=200 lbs. superphosphate per acre.

B=200 lbs. rock phosphate per acre.

C=400 lbs. rock phosphate per acre.

D=No phosphate.

Yields: A=7,587 lbs. per acre.
B=6,975 lbs. per acre.
C=8,125 lbs. per acre.
D=6,737 lbs. per acre.
} Green weights.

APPENDIX C.

APPLICATIONS OF ROCK PHOSPHATE TO PEDDIE FINGER GRASS. (BLOCK 44).

A=800 lbs. rock phosphate per acre.

B=400 lbs. rock phosphate per acre.

C=200 lbs. rock phosphate per acre.

D=No fertiliser.

Yield in lbs. per Plot.

	ROWS.				Totals of Rows.	Totals of Treatments.
Columns	A. 75.8	C. 80.5	B. 89.8	D. 70.0	316.1	A=271.9
	C. 72.8	D. 62.3	A. 74.8	B. 78.3	288.2	B=282.9
	D. 47.0	B. 62.5	C. 55.0	A. 61.3	225.8	C=260.3
	B. 52.3	A. 60.0	D. 44.0	C. 52.0	208.3	D=223.3
Totals of Columns	247.9	265.3	263.6	261.6	Grand total	=1038.4

Analysis of Variance.

Due to	Sum of Squares.	Degrees of Freedom.	Variance.	½ Loge Variance.
Total	2578.06	15	—	—
Rows	1946.09	3	648.70	—
Columns	47.35	3	15.78	—
Treatment	503.09	3	167.70	2.56113
Error	81.53	6	13.59	1.30469

Calculated value of Z=2.56113—1.30469.
=1.25644.

*Observed value of Z = .7798.

Therefore treatment differences are significant.

A	B	C	D	Mean	Standard Error.
271.9	282.9	260.3	223.3	259.6	7.4

Conclusions.—Differences 3 times the Standard error (or 22.2) may be reckoned as significant.

Therefore B is significantly greater than C and D.

A, B and C are significantly greater than D.

Yields: A=13,600 lbs. to acre.
B=14,150 lbs. to acre.
C=13,000 lbs. to acre.
D=11,100 lbs. to acre.
} Green weights.

APPENDIX D.

Application of Superphosphate to Kafue Rhodes Grass. (Block 46).

A=200 lbs. superphosphate to the acre.

B=400 lbs. superphosphate to the acre.

C=800 lbs. superphosphate to the acre.

Yield in lbs. per Plot.

Block.	Treatment. A	B	C	Total.
1	72.5	57.5	59.0	189.0
2	63.3	41.5	55.8	160.6
3	32.3	45.8	28.8	106.9
4	30.5	17.5	29.3	77.3
Total	198.6	162.3	172.9	533.8

Analysis of Variance.

Due to	Sum of Squares.	Degrees of Freedom.	Variance.	½ Loge Variance.
Total	3203.44	11	—	—
Blocks	2560.22	3	853.41	—
Treatments	174.22	2	87.11	2.23359
Error	472.00	6	78.67	2.18264

Calculated value of Z=2.23359—2.18264=.05095.

*Observed value of Z =.8188.

Conclusions.—Treatment differences are not significant.

Yields: A=9,950 lbs. per acre.
B=8,125 lbs. per acre.
C=9,087 lbs. per acre.
} Green weights.

*Vide Table of Z appendix to "Statistical Methods for Research Workers," by R. A. Fisher.

Compost and Witchweed

By S. D. Timson, M.C., Assistant Agriculturist.

The report of Capt. Moubray's experience of the effect of compost on maize planted on soil infested with witchweed given below is very welcome, since it goes far to confirm the remarkable results obtained on the farm of Mr. C. Tapson, at Concession, as reported in a note published in the October, 1938, issue of this Journal under the heading "Humus and Witchweed." In this latter trial the land was again planted to maize during the past season (1938-39) without any further treatment and again no witchweed appeared on the land treated with compost in 1937, whereas the maize on the untreated land immediately adjoining it was again severely infested with the parasite. Frequent careful searches for the parasite on the area treated with compost (about 3½ acres) were made by Mr. Tapson throughout the past growing season, and several by the writer, but none was found. The maize again made excellent growth on the treated land, despite the fact that the first sowing failed and the second sowing was therefore late. The untreated maize next door again made very poor growth.

Further evidence of this protective effect of compost on maize planted on infested land is reported by a Lomangundi farmer. A light dressing of compost at about 3 to 4 tons per acre was applied in this case and the maize made excellent growth despite the excessive rainfall and was estimated to yield at least 12 bags per acre, and practically no witchweed appeared above ground. The adjoining untreated maize was obviously affected by the attack of the parasite, and the yield much reduced.

Capt. Moubray's report is given below:—

Chipoli,
Shamva,
May 26th, 1939.

Sir,

I have a piece of land eighteen acres in extent which during 1936-37 was planted half to tobacco and half to cotton. The soil is of a lightish red and cannot be called rich.

Next season, 1937-38, the whole of the land was planted to maize with a dressing of some 200 lbs. of bone meal per acre. That half which grew tobacco the previous year gave a return of 11 bags of maize per acre and the half that had been planted to cotton 9 bags per acre, an average over the whole of 10 bags per acre.

Last year the whole land was dressed with a little over five tons of compost per acre, the equivalent of some 200 lbs. of bone meal per acre having been mixed with the compost during its manufacture.

Harvesting has just been completed, the result being just a little over 17 bags of maize per acre.

During 1937-38 witchweed infestation was considerable, the ground that season was cleaned three times. During 1938-39 the ground was only cleaned once, and yet the witchweed was only a small fraction in quantity of what it was the previous season.

The rainfall during 1937-38 was 38.1 inches and during 1938-39 it was 40.9 inches, so the extra moisture had little or nothing to do with the greatly increased yield and the reduction in the amount of witchweed.

To what extent compost has to do with the lessening of witchweed infestation has yet to be proved, but Captain Timson, who examined the crop just before it was reaped, tells me that similar results have been recorded in other parts of the Mazoe Valley.

I am, Sir, etc.,

J. M. Moubray.

The further investigation of this matter is being pursued on the witchweed demonstration farm recently opened by this Department near Glendale, in the Mazoe Valley, but farmers are again urged to test for themselves this effect of compost on maize grown on land severely infested with witchweed and to report the results obtained to the Agriculturist, Department of Agriculture.

Dressings of at least 8 tons (16 cubic yards, or Scotch cart loads) per acre should be used. Owing to its obvious importance as much evidence as possible on this point is desirable, and under varying conditions of soils and season. From the purely practical standpoint maize farmers are advised to apply their compost to their infested fields, since it is apparent from the experience of the three gentlemen quoted above that they will obtain a much greater increase in yield of maize than by applying it to maize on land free from the parasite.

PEOPLE LIKE YOU
have thought somewhat on the subject of agricultural cleanliness, and, because you have applied its principles and have become an asset to the State,
PEOPLE LIKE YOU.

Soil and Water Conservation

PART II.

CHAPTER V.—CONTOUR RIDGES.— (*Continued.*)

By D. Aylen and the Irrigation Officers.

CONSTRUCTION AND MAINTENACE OF CONTOUR RIDGES.

Preliminary Work.—The Line of Pegs.—On ground which frequently changes slope the ridges should be built just below the pegged line, so that the trough follows the true line of levels.

The pegged line may be straightened slightly so that any sharp bends due to very local inequalities are smoothed out. This should be done with caution, however, particularly on steep ground and sand veld.

It is usually most satisfactory to smooth out the line at the time of pegging so that if it is thought any diversions from the apparent line are due to purely local irregularities in the ground they may be checked. The engineer or local technical assistant will usually have checked and adjusted the line of pegs where smoothing of bends is desirable. However, there are a number of farmers who prefer to do it themselves. It must be first ascertained that no previous smoothing has been done. The less the movement of the pegs the more satisfactory the future behaviour of the ridge.

Pegs should only be moved uphill with extreme caution. In any case, alternate pegs should not be moved more than the fall given between adjacent pegs to avoid the gradient on any section being reversed. If adjacent pegs are moved, the movement should be such that the total movement of the two pegs does not amount to more than the fall given from one peg to the next.

Farmers, however, are advised not to move the pegs and smooth out the line of the ridge unless they are able to check the new levels accurately.

The safety of a ridge depends almost entirely on the water flowing at a constantly increasing speed.

Irregularities in the grading of a ridge result in scouring at the steeper sections and a dangerous deposition of silt in the flatter sections.

Sharp bends in the last 100 feet of ridge should not be straightened, since there is frequently a hollow and bank at the edge of the land due to ploughs turning there and there is serious risk of the outlet level being considerably higher than the trough of the ridge at the edge of the land if the pegged line is altered, and in addition it should be noted that the ridge should be banked up in crossing the hollow as shown in Fig. 28.

It should be an invariable rule to inspect all ridges every year.

Crossing Gullies and Wash-outs.—In cases where it is intended to cultivate the ridges, it is a waste of labour to completely straighten the ridge and build up very high banks when crossing gullies, and the line can partly follow the sharp bend caused by any wide depression.

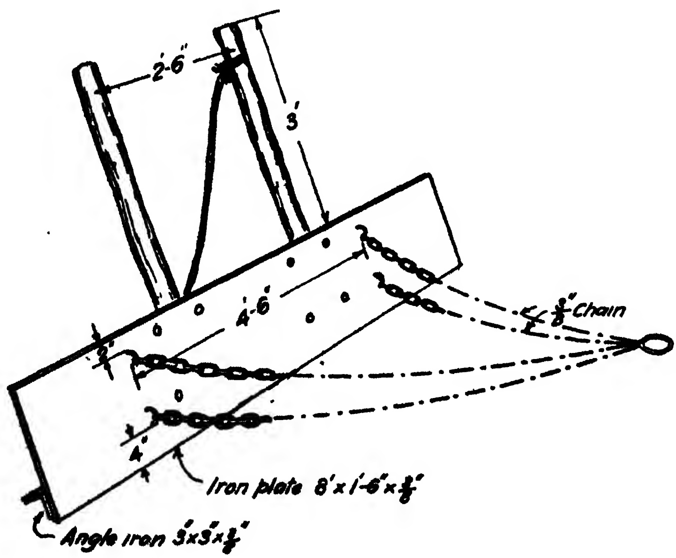
Narrow gullies need not materially alter the line of a ridge, as it can be taken across these on a normal easy curve and the bank made correspondingly higher between the shoulders of the gulley. Do not overlook the fact, however, that before the gully cuts down to its present level it may have started as a broad wash, and it is advisable in such cases to put pegs at closer intervals and set out a smooth curve across the depression and enable the gully to be crossed with as little extra filling as possible. Many of these original broad washes are over 100 ft. in width and may be as wide as 200 ft. Fig. No. 32 indicates how the crossing should be made.

It simplifies subsequent construction if the gully is first filled up to the bank level at the place to be crossed by the ridge. Mark the positions of the foot of the embankment

by pegs in the bed of the gully, placed (both upstream and downstream) at a distance from the centre line of the ridge equal to one and a half times the depth of the gully plus half the specified width of the ridge itself at ground level. Measure the depth of the gully by tightly stretching a long string between the pegs originally placed on the normal ground surface away from the gully, and not merely from the bank of the gully itself.

The above figures give a side slope of $1\frac{1}{2}$ to 1 which is the very steepest slope applicable to stable soils such as red loam. On soft sand soils and in black vlei the slope must be flattened to $2\frac{1}{2}$ to 1, which means that in the latter case the pegs for the toes of the bank should be placed at a distance equal to two and one-half times the depth of the gully plus half the width of the ridge itself at ground level.

Gully crossings should never be built wholly or partly of stones or timber stakes with the object of steepening the



"Evans" Leveller for 6 oxen

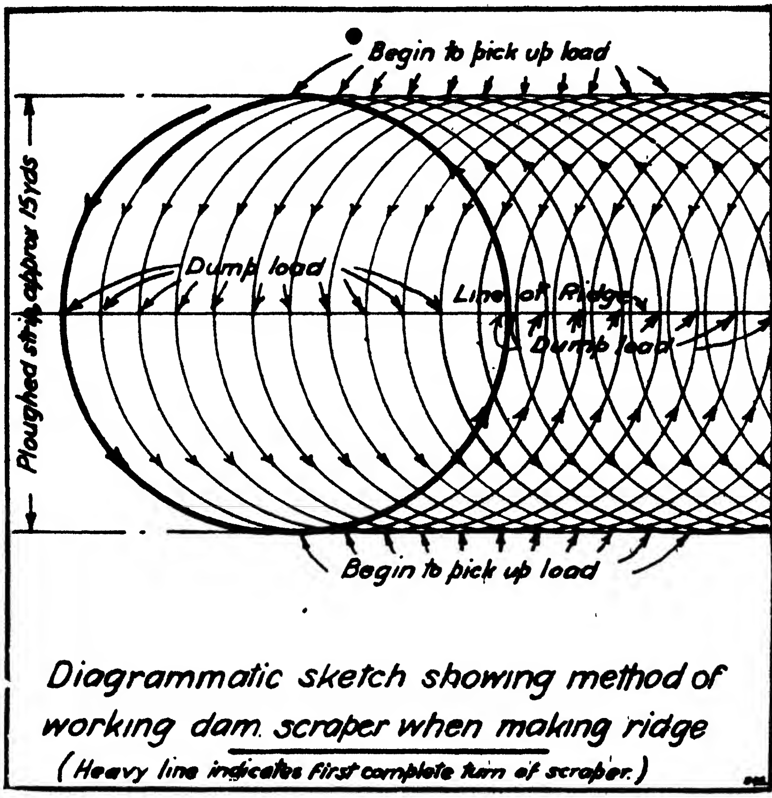


Fig. 33.—A. Land Leveller. B. Method of working dam scoop.

slope and reducing the width of bank; but paving the upstream face of the embankment in the case of deep gullies is a sound practice.

The preliminary filling, or rather smoothing, can be done by knocking in or ploughing in the sides of the gully for some distance above and below the line of the ridge. The embankment can and should be built with a land-leveller (Fig. 33A) or a dam scraper. The correct method of using a dam scraper, to obtain the soil from the proper place, is shown in Fig. 33B. In other cases, sufficient soil may be obtained from a near-by antheap, thus killing two birds with one stone. The width of the embankment at original uneroded ground level should not be less than 8 feet and the ridge itself can then be made up to full height by continuing to

use the dam scraper or leveller as before. All earthwork, even when consolidated by using a dam scraper or land leveller, is liable to settlement, and at gully crossings it is very important that the top of the ridge should be raised to an extra height. The extra height allowed should be 2 inches for every foot of height, and a slightly greater amount for hand work. Thus for a gully 3 feet deep the top of the ridge at the crossing should be 6 inches higher than the top of the ridge at the nearest pegs. This should be carefully checked, even at small gullies, by a string level, or boning rods which have been described on previous pages.

Gullies are a source of danger, even after the land has been ridged, as owing to the concentration of water in them erosion occurs and banks of silt are deposited against the ridge which is liable to be overtopped due to these obstructions.

Small checks of brushwood or stakes and trash backed with earth should be built across the gully at 10 yards intervals in order to enable the silt to be deposited in the gully before it reaches the line of the ridges. This precaution is of particular importance in sand veld.

Time of Construction.—Each type and condition of soil requires some modification in the method of construction. Different kinds of implements work best on different soils. No ditcher, dam scraper, leveller or plough works economically on clayey soil when moist, or on hard dry cloddy soil.

The best time to work in sandveld is when it is wet or damp, and for heavier soils when they are just dry enough not to stick to an implement. Fallow sandveld lands can be ridged any time during a normal wet season; green-cropped lands, on all except wet black vleis, can be done at any time from one month after "ploughing in," and many lands under side-crops are clear from that same time onwards.

On most well-run farms, therefore, at least one quarter of the lands will be available at the time that the soil is in the best condition for building ridges economically and well. At this time of year there is little work for oxen, they are fit, grazing is plentiful, the temperature moderate, and the soil is soft, whereas in September and October the conditions are

just the reverse. The moral is to do as much of the work as possible before August, and in a surprisingly few years the whole farm will have been done. The soil is literally the basis of the farm and its protection to ensure profitable working should not be regarded as the last of the odd jobs to make work for an otherwise idle gang.

However, a farmer without previous experience of ridges should not take on too much the first year. It is better to gain experience on a smaller scale, and do it properly, than attempt too much and have extensive failures. There are many little points to be learnt as the work proceeds, and it is easier to make good ridges than to repair defective ones, and easier to make them a little too high than to raise them later. Maintenance during the wet weather is costly and trying, and a broken ridge does more damage than none at all.

After making the first ridge, measure it up honestly with plank, spirit level and tape, and compare it with the recommended size, which is none too big, and see that all is well for height and width, particularly at dangerous points.

Referring back. Fig. No. 30 shows how the dimensions should be checked. The correct sizes are given in Fig. 27, whilst methods of checking sizes and eveness of grade are described on pages Nos. 42 to 49.

Cuttings through antheaps and mounds are undesirable, but if they have been unavoidable, they should be of ample depth and *width*. The bottom width of a cutting should be 2 feet wider than the bed of the channel, and the upper bank of the cutting must not be left vertical but must slope back at least 1 foot for every foot in depth.

The only satisfactory method of checking hand made ridges is to ensure they are made to size. Natives will soon slack off or attempt to skimp the work. This is readily checked if they are given the devices shown in Fig. No. 30.

Some farmers make ridges that do not break, others are surprised when they break, and other expect them to break. If correct methods are followed, and a little trouble taken, there is no need for any breaks at all.

METHODS OF CONSTRUCTION.

(1) **By Hand Labour.**—Owing to our cheap labour, and the cases such as tobacco farms where a large gang is available, many contour ridges, especially on small acreages, are built by hand. There is nothing against it, if the common faulty type of ridge is avoided, and ridges are built to a substantial size, as shown in Fig. 27. Soil can be taken from both sides of the ridge, or the upper side only on steep or eroded land or land intended for tobocco, and inclined to waterlog, when a water channel is desirable. If the land has been ploughed (and harrowed, if cloddy), fairly rapid progress can be made, and the daily "task" of finished ridge will be between 15 and 25 linear yards per native, depending on the type and depth of soil and type of ridge. Hand-made ridges are more liable to settlement and damage by animals, cultivators and rats than machine-made ones, and it must be emphasised that the consolidated bank should be 18 inches high above ground level and the water channel wide (6 feet bed with) and at least 6 inches deep, giving a total height of 2 feet, Type "C," and 4 feet x 2 ft. 3 in. Type "D." The minimum stable width of the bank is 8 feet.

(2) **By Dam Scraper.**—This method appeals to many farmers, and has several solid advantages. It is a cheap implement, is simple to operate, requires very little supervision and produces better consolidated ridges than by hand. The chief disadvantages are its slowness compared with a ditcher, and the removal of only topsoil to form the bank.

A good rate of progress can be maintained if 3 or 4 scrapers are used simultaneously, as each scraper, with a driver, leader and "operator," and 4 to 6 oxen, can build 100 yards of finished ridge per day, except for trimming.

The line of the ridge should first be marked by ploughing close to the line of pegs on each side, throwing towards the pegs. If the land has not already been ploughed, the ploughing should be continued over a strip of at least 15 yards in width.

The method of working the dam scraper is illustrated in Fig. 46, the point about it being that the team makes the same-sized turn the whole way, and each time it crosses the

line of the ridge it dumps a load next to the load placed on the previous crossing in that direction, thus eliminating short-turning. The team should make a turn sufficiently large to cover the whole of the ploughed strip, and it is important that a skimming cut should be used, and no attempt made to dig in deeply, which is hard on the oxen.

If the correct procedure is followed, a well-shaped rounded ridge similar to Fig. 27A will be produced, and it will be consolidated by the trampling of the oxen and of an easy shape for planting. Maintenance is reduced to a minimum, and can be carried out as described in a later paragraph.

An advantage of using a dam scraper is that the same implement is one of the best suited for filling up gullies and wash-outs.

(3) **By Land-leveller.**—The procedure is exactly the same as for the dam scraper, but with more particular care in the correct method of turning. Short turns invariably overturn these implements.

The Hobson type of land-leveller consist of a blade, usually concave, with long lifting handles running backwards, and either a runner or wheeled carriage or else a long dissel-boom in front. The load is picked up by pressing the handles, and dumped by lifting them. While quite suited to levelling land, the work of making contour ridges is exacting and tiring to the operator, as he has alternately to press down the handles to pick up a load, and then raise them at least 3 feet in order to lift the implement over the bank.

The Evans type is a simpler design, and needs no great strength on the part of the operator. Small ones for two oxen can be made from an old railway sleeper and are most satisfactory. The largest size for 6 to 8 oxen consists of a sheet iron plate (or timber with an iron bottom edge) 6 to 8 feet long and 18 inches high. Four chains are fixed to it by shackles, and joined together at a ring by which it is pulled. Two handles either straight or bent (see Fig. 33A) are bolted to the plate.

When required to pick up a load, it is held in position shown in Fig. 33A. To dump, the handles are pushed forwards

and released, when it will fall flat. By slightly pulling or pushing the handles, the amount of pick-up or dump can be varied.

A short rope is usually tied to the top of the left-hand handle, if straight, and to pull up the implement a sharp tug is given on the rope and as the blade comes up the right-hand handle is caught. To pick up a big load it is advisable to stand on the implement; if the chain-lengths are correct, balance is easy, the operator stands upright holding the handles behind him.

(4) **By Ditcher and Plough.**—Although good ploughing is an advantage for any method of construction, it is of prime importance for ditcher work. Except in very soft soil a disc plough is needed. There must be a minimum of slack in the bearings of wheels and discs, and the steering and lifting levers should work smoothly. One cannot steer on smooth curves if bearings are slack and the plough is out of alignment. New 26 inch discs are most desirable, as it is impossible to make big ridges with badly worn discs even if the number of rounds is doubled.

Figs. 34 and 35 show the size and shape of typical ditchers. The land-slide, *i.e.*, the part which runs in the plough furrow, should be at least 10 feet long, but there is little gain in having it longer than 12 feet, although it must be as long as the grader blade and extension. The grader blade should be at least 9 feet long for dry cloddy soil, and up to 12 feet for damp or loose soil. Some makes of ditcher require an extension, clearly shown in the photograph, fitted to the grader blade. When opened to give a "width" of 6 feet, the angle will be about 45° for the 9 foot blade and 30° for the 12 foot blade. These are the greatest angles at which the soil will slide up for the conditions outlined.

There are several makes of ditcher available such as the "Martin," "Lockie," and "Morris," each capable of good work under suitable conditions. Two types of farm made ditchers were fully described and illustrated in Departmental Bulletin No. 96, "A Home-made Ridger." Advice of the various types of ditchers can be obtained from the Department.

Fig 34 —Martin ditcher

Fig. 35.—Morris Ditcher.
Fig. 37.—Type "C" Contour Ridge

Striking out the Marking Furrow.—It is essential that the following method of striking out the marking furrow should be adopted when ridges are to be constructed by three-furrow disc plough and ditcher, and this method is also strongly recommended whatever the means by which the ridges will be constructed.

In any case the greatest care should be taken in order to ensure that the channel accurately follows the pegged line, as it has been found that when ridges have to deal with large volumes of water any inequality in the grade of the channel causes a dangerous restriction of the flow which is later accentuated by a very local deposit of silt.

The safety of a ridge apparently depends to a far greater extent than usually reckoned on a smooth or even flow in the channel. It is for this reason that it is stressed that any straightening of the line must be kept to an absolute minimum and also the reason why on uneven or steep ground pegs should be placed much closer when marking out ridges or drains.

Place a line of sighting sticks long enough to be seen from the plough-seat from 4 to 6 feet, but all the same distance, below the original pegs; in that way the "trough" is made exactly to follow the original lines. This is the time to carry out any straightening of bends in the original line if this has not already been done, and the sticks should be aligned as previously described on page 53, afterwards the pegs should be altered to correspond with the long "sighting" sticks, and will form a valuable guide after the latter have been knocked down.

"Striking-out" with a single-furrow mouldboard needs no explanation. The gang mouldboard and the two-furrow reversible disc plough are not really suitable implements for marking smooth curves. The three-furrow disc plough when correctly used is a most suitable implement, and does a lot of the work, actually pushing up the soil to form the ridge, besides loosening it so that the ditcher can work with maximum efficiency.

Method of use of Ditchers.—The striking out furrow should be done with the plough throwing the soil downhill, Fig. 38 (that is the slope of the land is down to the right), and the

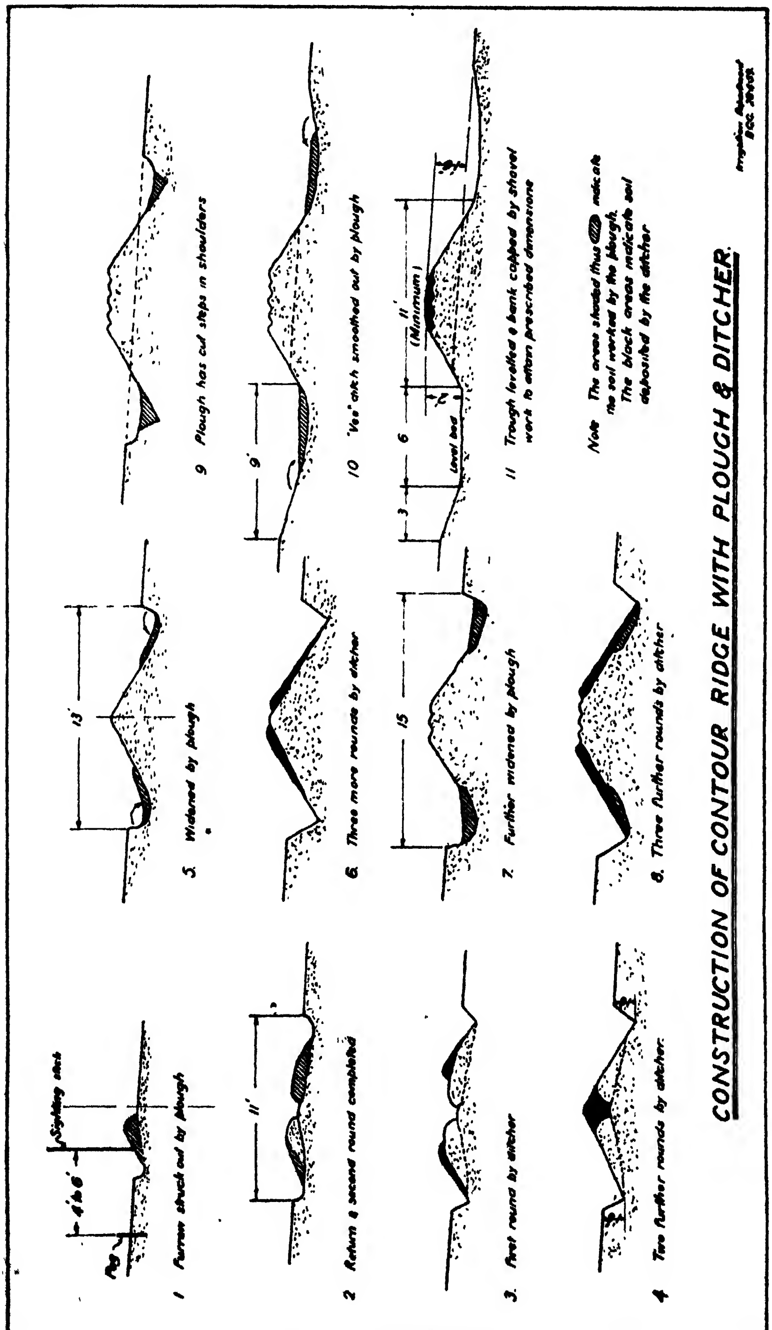


Fig. 38.—Construction of Ridges by Ditcher.

left hand or land wheel running along the pegged line, whilst the back disc and the operator pass over the line given by the long sighting sticks. In striking out the front disc should barely touch the ground and the back disc should be set quite shallow.

By sighting on two or three sticks ahead, very smooth curves can be made, and a check is kept by observing the original pegs as they are passed. The team is kept straight ahead of the plough, the leader only swinging round the bends when the plough gets to them. It is impossible to make a smooth curve if the leader follows the line and attempt is made to control the plough by using the hind oxen and the steering lever excessively. It is most important to avoid kinks, as they will throw the ditcher out of the furrow.

At sharp bends or if the team is not straight, stop and put the team right. The oxen will then learn quickly. Do not allow the driver to hit the oxen, hurry them or get on the off-side; make him ignore the hind oxen and rely on the front oxen. Have an intelligent native as a leader, and use the steering lever to a minimum.

On reaching the far end, the plough is entered for the return journey below the pegs so that it throws towards the first furrow. To avoid overturning the plough on a sharp right hand turn, make a "figure of eight" turn by first swinging to the right and then turning to the left.

Usually on the return journey the front wheel follows the track it made on the forward one, but the exact line depends on the final width of ploughed strip that is desired, according to the state of the soil and the size of the ditcher. A second round is now made outside the first and with the plough set as deeply as possible.

A ditcher does not work well if opened wider than 30° for damp soil and 40° for dry soil and 45° for soil with small clods,

The width of the ploughed strip (after two rounds) should be twice as wide as the effective width of the ditcher under soil conditions as defined above.

If the soil is hard the strip should be re-ploughed.

The ditcher is next entered with the landslide in the furrow and the grader-arm over the strip, held up waist-high at the end. Two natives weight the land-slide. See Fig. 39. The first round is intended to clear a furrow for the ditcher to run in the following round. Take great pains that the ditcher does not kick out, for if it does it will do so afterwards every time at the same point. The hitch clevis should be in the hole nearest the land-slide. Use at least four feet of hitch chain and any recognised means of relieving the downpull on the hind oxen. One line of oxen walks in the furrow and the other on the ploughed strip, except on curves, when they must be kept straight ahead. It may assist to work the ditcher throwing to the left, as then the off-side oxen will walk in the furrow. Figs. 39-42 clearly shows the position of the oxen.

If the soil sticks to the blade, this can be overcome by leaving the turned up soil to dry for a day before entering the ditcher. Also if a green-cropped land has just been ploughed a sufficient time should be left for the soil to settle as the land-slide of the ditcher must have a firm furrow to press against.

With the next round of the ditcher the work of pushing up the soil begins. It is entered as before, but the native on the arm only lifts it when crossing places where liable to kick out. The live load on the land-slide is adjusted if necessary. Do not press down the arm, but rather lighten it by pulling on the post. One or two more rounds now follow until the size approximates Fig. 38 stage 4. Some weight may now be put on the arm. Usually a live load of two boys is ample, and pressure is applied by pushing inwards on the post. If the tail tends to kick out of the furrow, or the nose run in to the centre of the ridge, move the hitch clevis in one hole. The shape of the "peak" of the ridge depends on the width of the ploughed strips, and how the soil has slid up the arm. By this time the correct width of ploughing and the best opening of the ditcher should have become obvious, and can be adopted for the rest of the ridges.

* The majority of ditcher-made ridges fall miserably short of the correct size and numberless failures result as most

Fig 44 —Ridge crossing small gully

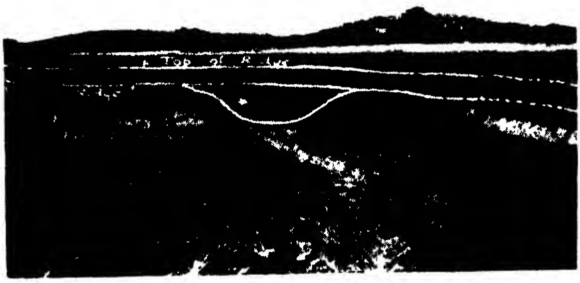


Fig 45.—Ridge crossing big gully

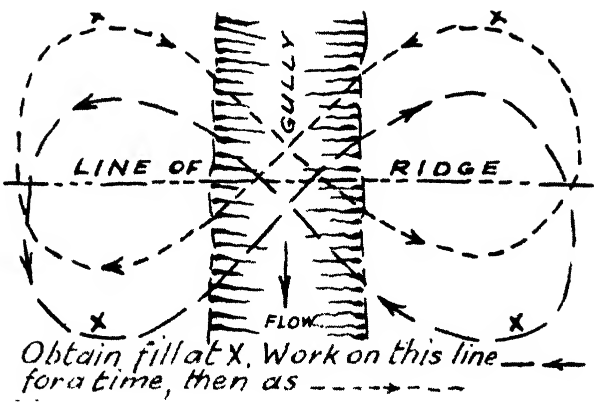


Fig. 46.—How to work a dam scoop at gully crossings.

farmers consider that by this time they have completed the work and omit the further stages of construction, whereas so far little more than the base of the bank has been made.

The plough is now used to deepen the bottom of the V furrow and also take in about 6 inches of new ground. Adjust the straps or other device so that on the land-wheel side the frame can be lowered almost to touch the ground. The plough is entered in the furrow so that only the back disc is biting new ground, and it is going in as deep as possible. Eighteen inches total depth is easily attained if the settings are correct. The oxen walk in the same position as in previous rounds (Fig. 40). This operation is quite easy if the plough is in good order, and no attempt made to hurry the oxen. The team must be kept straight. The width of the cut must not vary.

Three or more rounds of the ditcher now follow. If the "V" ditch is deep and clean-cut the oxen may now take up positions as for ordinary ploughing, but the hitch must be adjusted accordingly. As before, the first round cleans the furrow, and though only a pull on the pole is generally required, the grader arm must be lifted at all gullies or hollows. For the succeeding rounds some pressure must be applied to the arm, but a small amount of soil should be allowed to slip under the top end and be packed. If too much pressure is applied, an impressive amount of soil comes out at the end, but most of it rolls down again. Fig. 38 Stage 6 shows where the soil must be packed to widen and slightly raise the bank.

The plough is now used again to widen the furrow slightly and deepen it as much as possible. (Stage 7.) This is followed by several rounds of the ditcher.

A further cycle of plough and ditcher may be needed, but by now the bank should have the correct shape (Fig. 38 Stage 8).

If necessary, the ditcher may be opened wider in the later stages, but efficiency is generally reduced, especially after the slope has become steep. When the widest angle at

which soil readily slides up has been found, it is as well to keep it. All the ridges in the photographs were made without altering the angle of the ditcher.

Filling in the V ditch is next done by the plough. As the ditch may be up to 24 inches deep the plough cannot take a full cut, so it is run along with only the back disc taking a bite, but this time set shallow. This forms a step, Stage 9. The next round the front wheel runs on this step, and this is followed by another round outside The plough then makes 3 or 4 more rounds starting as close as possible to the ridge on the first trip, and on the final trip when it is about 6 feet away from the ridge it is run along merely to close the last furrow, and as shallow as possible. See Fig. 38 Stage 10 and Fig. 42.

If desired, a small amount of earth can be shovelled out of the trough, so as to make it perfectly level, and used to cap the bank, Stage 11. Fig. 36 shows a completely settled ridge, 18 months old, made like this.

Useful Hints.—The ditcher can be steered a bit at the early stages by changing the position of the load.

As the load on the arm is increased, adjust the hitch clevis by moving it in, but always so that more side pressure is exerted at the tail than the nose.

By lifting the arm at gully crossings, skidding is prevented.

A perfectly even finish to the side slopes is obtained by pressing down the arm on approaching lumps and pulling upwards at small hollows.

If clods are troublesome, reverse the ditcher each trip and it will push them up.

Remove all roots, stones, etc., that are met.

Keep a high polish on the grader-blade.

Ridges made by Single Furrow Plough and Ditcher.—When sandveld is wet, ridges can be made very successfully by using a single-furrow mouldboard plough and ditcher.

The marking-furrow is struck out as before, and on the return trip a furrow is ploughed about 10 feet below. It is advisable to mark this with pegs, as the width must be constant. The ditcher is then entered as before, but perhaps set a little less open.

The procedure is as before, except that as the plough has a shallower cut it is necessary when widening to go over the same ground two or three times each time.

Single-sided Ridges and Drains.—On eroded or steep land, *i.e.*, land having a slope of 1/20 or more, the single-sided ridge possesses many advantages. (See Fig. 27C.) There is no defined V ditch on the lower side. Soil cannot be easily pushed upwards on a steep slope after the first round of the dicher. A ditch below would collect water from the lower slope of the ridge and cause erosion at gullies. All ridges constructed on steep slopes must have a defined trough on the upstream side and this trough must be kept clear. (See Fig. 37.)

To make a single-sided ridge the ploughing is done exactly as before, but the ditcher is first worked on the lower side only until all available soil has been pushed up, and in all subsequent rounds the ditcher is worked on the upperside only and the plough returns on the lower side either light or is utilised for normal ploughing of the land.

Contour Ridges for Gently Sloping Land.—On land with slopes of less than 1 in 40 the major part of the work may be done by disc plough.

The furrow is struck out as before, but on the return trip a narrow strip between is left unploughed, to serve later as a guide.

Two more rounds are then made with the plough set as deeply as possible, unless the soil turns up very cloddy, when it would be advisable not to plough very deep in order to reduce the size of the clods.

The plough is now entered with the front wheel in the centre of the unploughed strip and three more rounds completed throwing towards the centre as before, and re-ploughing the original strip.

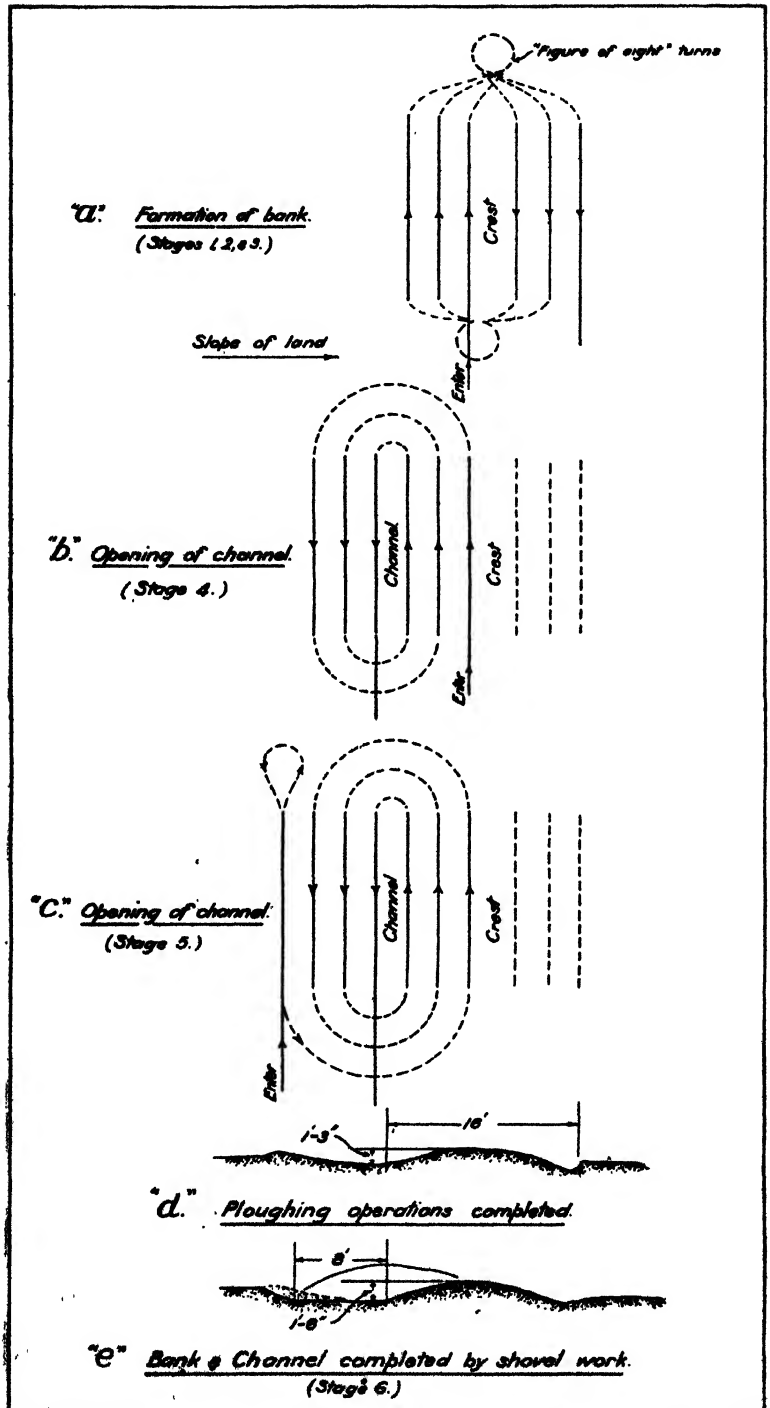

"Figure of eight" turns
"a." Formation of bank.
(Stages 1, 2, & 3.)
Crest
Slope of land
Enter
"b." Opening of channel.
(Stage 4.)
Channel
Crest
Enter
"C." Opening of channel.
(Stage 5.)
Channel
Crest
Enter
1-3"
16'
"d." Ploughing operations completed.
8'
1-6"
"e" Bank & Channel completed by shovel work.
(Stage 6.)

Fig 47.

A further three rounds are now made, ploughing the original strip for a third time. Fig. 47 "a."

The plough is now run along with the front wheel on the top of the bank, but on the return trip the plough is entered in the land just above the ridge at such a distance that with two more trips it will complete the ploughing of this strip and make a finishing furrow so as to form a water channel just above the ridge. If the land wheel on the return trip is kept about 2 ft. 6 in. from the edge of the ploughing the distance will be correct. Fig. 47 "b."

The trough or water channel is enlarged and the bank caused by the last opening furrow reduced by again ploughing out the trough as follows. On the outward trip go along with the front wheel running just within the ploughing above the ridge, and the plough taking new ground. On the return trip this furrow is thrown back, then on the way out the plough is entered on top of the bank, and three more rounds completed exactly on the ground and in a similar manner to that described in the previous paragraph. Fig. 47c.

The ridge, except for making up of hollows and digging down of mounds, is almost complete. The water channel should be widened and the bank raised by shovelling soil from *above* the finishing furrow and throwing on to the top of the bank. Fig. 47e.

The ideal channel should have a bottom width of 8 ft. and the bank should be 16 ft. wide and at least 15 inches above original ground level, giving a total height of 18 inches. (Type "B" ridge, see Fig. 27.)

For maximum water conservation or irrigation by storm water the shape attained and the ease of construction makes this an ideally suited method, where the ridges are much closer spaced than the standard spacing.

MAINTENANCE OF RIDGES.

As a matter of routine all ridges should be inspected after the first heavy storm and at the end of each season, when any weak points will be easily recognised by the "high water" mark, and should at once be attended to. Silt deposits at

gullies should be noted. A pool upstream of a cutting will indicate that the trough in the cutting is not deep enough.

Full-sized Ridges Reduce Maintenance. — Maintenance depends largely on the method of working the land, and on the *size and shape* of the ridges. The sizes shown in Fig. 27 may be considered excessive, and it is often thought that an official recommendation errs on the generous side and that a little cutting down is permissible. But let there be no mistake. The sizes now recommended are the smallest that experience has shown to be safe for a land in normal condition and they will then withstand storms up to 3 inches in an hour.

They require a minimum of maintenance compared with small narrow ridges, but that minimum must not be neglected.

Other reasons against reducing the sizes shown in Fig. 27 are:—

(1) An allowance must be made for settlement, especially in hand-made ridges.

(2) A "free-board" (height of ridge above maximum water level) must be allowed, as absolute accuracy of construction cannot be attained.

(3) Silting, especially at gully crossings, will reduce the "carrying capacity" of the ridge. Ploughing and weed growth will do the same. Any obstruction or filling of the trough must be guarded against by proper maintenance.

(4) Reduction of the height of the ridge by cultivation and "minor erosion."

Special attention must be paid to the clearing of the trough and the maintenance of ridges during the time that land is left fallow.

It is without doubt more satisfactory to make the ridges of substantial size, and base the need for maintenance on observation of actual results, than to make them too small with the intention of enlarging them later, an intention which

is invariably delayed until real damage occurs. Moreover, once a ridge has been built, it is difficult to raise it with a ditcher, although it can be widened.

The requisite amount of maintenance work must most certainly not be neglected, but provided that ridges are originally constructed to adequate size and the recommended spacings have not been execeeded, it is far from extensive. The extent is almost entirely dependant on the farming methods practiced.

Contour ridges of themselves are not the complete objective, but rather only the means to an end. *Contour ridges alone are not enough* and for *true* soil conservation it is of great importance, besides the usually recognised ones, that the land be kept in good heart and also that all working of the land be done with due care and on the contour. By these means not only is the soil movement into the channel restricted to a minimum, but also the volume of run-off during violent storms which might otherwise overtax the ridge is considerably reduced.

Thus good farming practices not only reduce the cost of maintenance, but in two ways greatly contribute to the safety of contour ridges. The likelihood of well planned, well made contour ridges on well farmed land being overtopped during even the worst storms is remote, and even then the very minor damage suffered would be restricted to the lower slope of the ridge.

The maintenance of full sized contour ridges of the standard types without recourse to hand labour, also ploughing systems which contribute to the maintenance (with the Type "B" ridge almost entirely obviate extra work) will be included in a later section of the Bulletin.

Urea as a possible substitute for Peanut Cake

FOR WINTERING YOUNG STOCK.

By C. A. Murray and A. E. Romyn.

Introduction.—Urea is a synthetic nitrogen compound obtained from atmospheric sources. It is used locally as an ingredient in fertiliser mixtures. It has, however, also been used recently to some extent on the Continent and elsewhere as a possible substitute for such cakes as linseed, palm kernel and soya bean, etc., for the feeding of cattle and sheep.

The experiments as to the feeding value of urea for this purpose have been inconclusive in many cases. It is, however, a comparatively cheap source of nitrogen which may be convertible into simple proteins in the animal. It contains approximately 46% of nitrogen as against about 7% in peanut cake. The comparative cost of the two feeds in this Colony are at present about £26 and about £9 per ton. The nitrogen in urea therefore costs less than half that in peanut cake.

The preliminary experiment described in this article was carried out to test the value of urea under local conditions. The results are promising but inconclusive. They are sufficiently encouraging, however, to justify more work on the subject and further experiments are in progress at the Government Experiment Station, Bulawayo. It is hoped that the results of these trials will be of great value to farmers in this country in that they may develop a cheap protein feed for the winter months.

A Review of the Present Position.—In previous work by the writers ([1] and [2]) it has been shown that our pastures are extremely deficient in protein during the winter months and that unless young growing stock are fed a protein supplement during this time of the year they lose condition rapidly and consequently mature very late.

As the protein supplement commonly available in the Colony—peanut cake—is usually very expensive and the supply often limited, it is realised that unless cheaper substitutes can be found the feeding of purchased protein supplements to young stock in the winter months will not become a common practice.

This experiment was, therefore, carried out to determine whether a cheap source of protein such as urea could be used to replace part or all of the peanut cake in a maintenance ration for young stock during the winter.

Recent micro-biological and chemical investigations of protein synthesis in the digestive tract have led overseas workers to carry out a number of experiments to determine to what extent non-protein nitrogen is utilised by ruminants. In view of these results and following on the discussion of (C.A.M.) with Dr. E. B. Hart, of the Wisconsin Agricultural Experiment Station, U.S.A., and Dr. Watson, of the Imperial Chemical Industries, Ltd., Jealotts Hill Research Station, England, it was decided to obtain some local information on the subject. With this object in view the preliminary experiment described in this article was carried out at the Government Experiment Station, Rhodes Matopo Estate, Bulawayo.

It may briefly be explained here that it has been claimed that ruminants can utilise, at least in part, the nitrogen of urea and certain ammonium salts such as ammonium bicarbonate and ammonium acetate. It is thought that the micro-organisms in the rumen use these simple nitrogen compounds for the building up of their own tissues, and so have a protein sparing action on the vegetable and animal proteins in the ration, and these micro-organisms in turn are digested further down the digestive tract.

A detailed review of the literature will not be made here, but to those who are interested we refer a complete review by Krebs(3) and Battie(4).

Quite recently Hart and his associates (5) and (5a) at the Wisconsin Station demonstrated that dairy calves can make use of simple nitrogen compounds as substitutes for protein.

Plan of Experiment.—The experiment was commenced on May 10th and concluded on 11th August, 1938. It was unfortunately not possible to continue the experiment for a longer period as suitable animals were only available for the time indicated.

Thirty pure bred and grade Red Poll heifers were used in the experiment varying in age from 10 to 18 months. The heifers were divided into three similar groups of 10 and the animals in each group were fed individually the rations shown in Table I.

TABLE I.—FEED INTAKE.

Daily Rations of the Three Groups.

	GROUP I.	GROUP II.	GROUP III.
Veld Hay (1)	6.8 lbs.	6.5 lbs.	6.6 lbs.
Silage (2)	10 lbs.	10 lbs.	10 lbs.
Cane Molasses	1.0 lbs.	1.7 lbs.	2.6 lbs.
Peanut Cake (7.4% N.)	16 ozs.	8 ozs.	—
Urea (46% N.)	—	1.3 ozs.	2.6 ozs.
Total N. in Peanut Cake and Urea	1.2 ozs.	1.2 ozs.	1.2 ozs.

(1) Assuming a dig. coeff. of 50% this veld hay contained 1.5% digestible protein.

(2) The silage consisted of approximately equal parts of maize and sunflower and, assuming a dig. coeff. of 50% it contained 1.4% digestible protein.

The three groups of heifers were kept in well sheltered pens 30 ft. by 40 ft. and each day at 11 a.m. and 2 p.m. they were taken out to water at a trough 200 yards away. Proper feeding mangers were provided and hay racks, which were kept full of hay to which the heifers had free access at all times. About midday each day the heifers were tied up at the mangers and were fed individually the quantity of silage, molasses and peanut cake and/or urea shown in Table I. These supplements were placed on top of the silage and then mixed together. After the heifers had finished their feed they were untied and left loose in the pens. They consumed freely the rations given to them.

Results.—The average weights of the three groups of heifers at the different intervals are given in Table II.

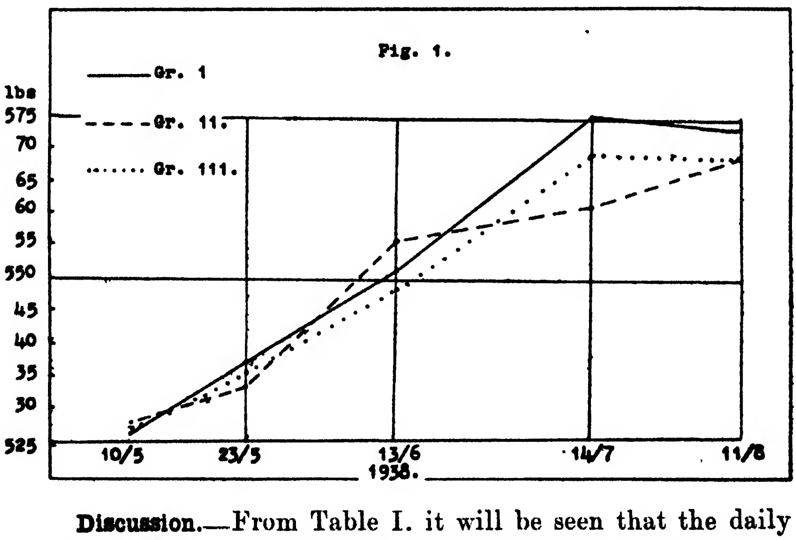
TABLE II.

Average Liveweight of the Three Groups.

Date.	GROUP I. lbs.	GROUP II. lbs.	GROUP III. lbs.
10/5/38	528	530	528
23/5/38	537	534	536
13/6/38	552	556	549
14/7/38	576	563	572
11/8/38	573	568	568

The rate of growth is illustrated graphically in Figure I.

Fig. 1.



Discussion.—From Table I. it will be seen that the daily intake of nitrogen in the form of either urea, peanut cake or peanut cake and urea was kept constant at 1.2 ozs. per day. When the amount of peanut cake was decreased, as in Groups II. and III., the quantity of molasses was increased so as to bring up the total energy intake to the same as Group I., whilst sufficient urea was fed to bring the nitrogen intake of Groups II. and III. also up to that in Group I. All three groups received, therefore, the same amount of energy and the same amount of nitrogen. In Group I. the bulk of nitrogen

was obtained from the peanut cake, in Group II. from a mixture of peanut cake and urea and in Group III. presumably from the urea.

From Table II. and figure I. it will be seen that the average weights of the heifers in Groups I., II. and III. were 528, 530 and 528 lbs. respectively at the commencement of the experiment. At the end of the 93 day feeding period the average weights were 573, 568 and 568 lbs. respectively. From both Table II. and figure I., it will be seen that at no time in the experiment was there any difference between the groups, and at the conclusion of the trial competent judges could not see any difference between the three groups in regard to the sleekness of coat or general health. From their general apparance the three groups of heifers did equally well.

The most interesting feature of this experiment is perhaps that Group III., which received all its supplementary nitrogen as urea, did as well as the other groups and gained 40 lbs. in liveweight for the 93 day period.

The amount of digestible protein supplied per day in hay, silage and molasses to this group was .24 lbs. per head. According to generally accepted standards of protein requirements (6, 7, 8) it is doubtful if this quantity would meet the maintenance requirements of the animals and, as they gained .43 lbs. in weight per head per day, it would seem likely that some use was made of the urea nitrogen. Recent work at this Institution(9) tends to confirm this conclusion in that it has been shown that growing animals of similar weights require from .4 to .5 lbs. of digestible protein per day to maintain their weights during the winter months and that .25 lbs. of digestible protein was insufficient for this purpose.

Further experiments are now in progress in which the vegetable protein intake of the control group has been further reduced so as to determine more definitely, if possible, the efficiency of urea as a protein supplement in the ration of young growing stock during the winter months.

Conclusion.—The results of this experiment suggest that urea can be utilised, at least in part, as a substitute for peanut cake.

Further work is in progress to check these results.

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Rhodesia Weather Bureau.

MAY, 1939.

Pressure.—The barometric pressure was generally slightly below normal, being lowest in the South, where the deficit was 0.5 mbs.

Temperature.—Mean temperatures were generally slightly high, the maximum being below normal and the minimum generally 1° F. or more above. The moisture content of the air as shown by the dew point at 8.30 a.m. was generally about 2° F. above the average.

Rainfall.—The rainfall recorded was slight but generally rather more than is to be expected in May. This was largely due to somewhat heavy showers which occurred on the 28th and 29th.

PRECIPITATION.

Station.	Inches.	Normal.	No. of Days.
Beitbridge	1.18	0.36	2
Bindura	0.01	0.50	1
Bulawayo	1.32	0.35	3
Chipinga	2.50	1.00	10
Enkeldoorn	0.25	0.32	3
Fort Victoria	0.41	0.33	3
Gwaai Siding	0.34	0.12	2
Gwanda	0.70	0.31	2
Gwelo	2.16	0.30	3
Hartley	0.23	0.26	4
Inyanga	0.37	0.50	5
Marandellas	1.02	0.62	6
Miami	Nil	0.04	—
Mount Darwin	Nil	0.45	—
Mount Nuza	1.69	1.55	14
Mtoko	Nil	0.34	—
New Year's Gift	0.55	0.43	6

Station.	Inches.	Normal.	No. of Days.
Nuanetsi	1.68	0.27	4
Rusapi	0.62	0.35	8
Salisbury	0.59	0.47	5
Shabani	1.17	0.45	3
Sinoia	0.35	0.35	4
Sipolilo	0.09	0.34	1
Stapleford	2.01	1.40	14
Umtali	0.29	0.51	5
Victoria Falls	0.35	0.42	1
Wankie	0.11	0.32	1

Abercorn	1.03	—	5
Balovale	0.02	—	1
Broken Hill	0.10	—	2
Fort Jameson	1.04	—	4
Fort Roseberry	0.93	—	3
Kapiri Mposhi	0.07	—	3
Kasama	0.06	—	1
Kasempa	0.42	—	1
Livingstone	0.02	—	1
Lundazi	Nil	—	—
Lusaka	0.17	—	1
Mankoya	0.28	—	2
Mazabuka	0.02	—	1
Mkushi	0.61	—	1
Mongu	Nil	—	—
Mpika	0.38	—	4
Mporokoso	1.29	—	9
Mufulira	0.50	—	2
Mumbwa	0.10	—	—
Mwinilunga	0.95	—	6
Namwala	Nil	—	—
Ndola	0.47	—	3
Senanga	0.01	—	1
Sesheke	Nil	—	—
Shiwa Ngandu	0.50	—	3
Solwezi	0.40	—	1
Plumtree	0.08	0.69	2
Que Que	0.51	0.24	1

MAY, 1939

Station	Altitude (Feet)	Temperature in Stevenson Screen at 4 feet °F: 8-30 a.m. Dry Bulb.	Wet Bulb.	Dew Point	Vapour Press. Deficit	Maximum	Minimum	Max. + Mim. ÷ 2	Absolute: Maximum	Date	Minimum	Date	Number of Days: Max. > 85°	Max. < 70°	Min. > 65°	Min. < 40°	Mean of 24 hours	Pressure Millibars: 8-30 a.m. Station Level	8-30 a.m. 1200 gdm.	Mean of 24 hours	Cloud Tenths	Sunshine Hours
Beitbridge...	1,486	65.6	59.2	55	7.0	82.5	55.1	68 8	96	14	47	23	13	1	...	...	68 2	968.6	885.2	...	3.5	...
Bindura...	3,700	63.3	57.5	53	6.0	76.2	50.2	63.2	83	14	44	3	...	...	...	...	63.4	...	...	...	3.1	...
Bulawayo	4,393	59.9	54.0	49	5.7	73.4	49.6	61.5	82	15	42	31	...	9	...	...	...	872 7	884.4	...	4.1	...
Chipinga	3,685	62.6	57.5	53	5.4	71.4	54 0	62.7	82	13	48	27	..	11	...	...	61.1	895.6	884.8	...	4.4	...
Enkeldoorn	4,808	59.9	53.9	49	5.8	72.5	50.0	61.3	82	13	42	3	...	6	...	...	59.7	860.4	884.5	...	3.8	...
Fort Victoria... ...	3,571	57.5	54.3	52	3.0	74 7	49.0	61.8	85	14	42	27	...	8	...	...	60.9	898 8	884.5	897.5	3.9	...
Gwaai Siding... ...	3,278	60.9	56.3	53	4.6	78.0	48.8	63.4	89	13	46	2	2	...	...	...	...	907 9	884 0	...	0.5	...
Gwanda...	3,233	62.7	56.3	51	6.5	75.5	51.3	63.4	87	13	42	27	2	8	...	...	62.4	909.8	884.5	...	3.3	..
Gwelo	4,629	60.4	54.3	49	6.0	72.0	49.7	60.9	81	14	44	3	...	8	...	...	59.8	865.3	884.2	...	3.5	...
Hartley...	3,879	61.8	56.0	52	5.8	76.9	49.1	63.0	83	14	43	3	...	1	...	.	61.7	888.7	884.2	...	2 4	...
Inyanga...	5,503	61.5	53.2	46	7.9	69.4	47.8	58.6	75	13	39	3	...	14	...	2	56 5	...	..	...	2.3	...
Marandellas	5,453	58.3	52.9	48	5.1	69.2	49.8	59.5	77	13	45	27	...	13	...	...	58.4	...	...	...	3.3	...
Miami	4,090	62.3	57.6	54	4.8	74 0	51.1	62 5	80	13	47	29		3	...	...	61.3	881.6	883.6	880.2	2.3	...
Mt. Darwin	3,179	65.1	59.7	56	6.0	77.0	51.4	64.2	84	14	45	2	...	...	...	...	63.1	...	...	...	3.9	...
Mount Nuza	6,668	52.2	48.1	44	3.5	58.8	46 7	52.8	72	13	41	25	...	29	...	...	51.6	803.6	884.5	...	5.7	...
Mtoko	4,136	63.4	55.5	51	7.1	71.6	53 3	62.5	78	19	48	26	...	13	...	...	61 4	880.9	884.5	879 6	2 3	..
New Year's Gift...	2,690	61.1	57.3	55	3.9	76.7	51.8	64.3	88	13	14	2	3	6	...	..	...	...	...	...	...	...
Nuanetsi	1,547	62.1	59.1	57	3.1	78.0	49.4	63.7	93	14	42	1	6	6	...	...	...	967 2	885.1	...	4.7	...

MAY, 1939 (continued)

Station	Altitude (Feet)	Temperature in Stevenson Screen at 4 feet °F: 8-30 a.m. Dry Bulb.	Wet Bulb	Dew Point	Vapour Press Deficit	Maximum	Minimum	Max. + Mim ÷ 2	Absolute: Maximum	Date	Minimum	Date	Number of Days: Max ⋗ 85°	Max < 70°	Min. > 65°	Min. < 40°	Mean of 24 hours	Pressure Millibars: 8-30 a.m. Station Level	8-30 a.m. 1200 gdm.	Mean of 24 hours	Cloud Tenths	Sunshine Hours
Plumtree	4,549	62.4	53.6	46	8.5	73.3	52.7	63.0	81	14	45	28	...	5	...	...	61.7	...	...	...	2.5	...
Que Que	3,999	61.0	55.4	51	5.6	77.0	50.8	63.9	85	14	44	2	...	1	...	...	62.6	885.3	884.5	883.8	2.6	...
Rusape	4,648	59.8	54.5	50	5.2	72.2	48.5	60.3	80	13	41	3	...	9	...	...	59.5			...	3.9	...
Salisbury	4,831	60.8	54.7	50	6.0	73.2	49.1	61.2	80	14	42	26	...	6	...	...	60.4	859.3	884.3	857.9	3.7	8.4
Shabani	3,131	63.0	57.5	54	5.7	75.4	52.1	63.7	86	15	45	27	1	10	...	...	63.1	...	...	...	4.1	...
Sinoia	3,795	61.3	56.7	54	4.7	77.9	47.5	62.7	85	14	42	3	...	...	...	...	...	...	...	...	2.3	...
Sipolilo	3,876	64.8	58.3	54	7.0	75.1	52.6	63.8	81	14	47	8	...	2	...	...	...	...	...	...	1.8	...
Stapleford	5,304	56.3	52.8	50	3.2	63.7	44.0	53.9	75	13	34	3	...	25	...	9	53.9	...	...	...	4.3	...
Umtali	3,672	62.1	58.2	56	4.1	73.6	53.1	63.4	85	13	46	4	...	7	...	...	61.5	896.4	885.2	894.9	4.6	...
Victoria Falls... ...	3,009	64.4	58.2	54	6.7	83.9	52.9	68.4	91	15	46	1	15	...	...	...	66.9		...	...	2.0	...
Wankie...	2,569	63.5	58.7	55	5.0	85.2	57.2	71.2	91	13	52	30	17	...	...	...	69.9	930.4	...	...	2.3	...
Abercorn	5,458	62.1	58.0	55	4.3	75.1	55.7	65.4	79	12	51	16	...	2	...	...	...	839.2	882.8	...	4.8	...
Broken Hill	3,911	62.9	57.8	54	5.3	77.5	54.2	65.9	84	13	47	28	...	1	...	...	...	886.6	882.8	...	3.1	...
Chipili	3,900	64.4	61.3	59	3.4	80.6	57.8	69.2	86	21	50	27	1	...	...	...	...	...	...	...	...	...
Fort Jameson ...	3,815	66.0	60.0	56	6.6	76.4	59.1	67.7	82	19	54	27	...	4	...	...	...	890.3	883.7	...	2.5	...
Kasama...	4,562	63.9	59.7	57	4.6	76.4	57.5	66.9	80	12	52	28	...	...	...	...	...	...	...	...	...	...
Kasempa	4,500	60.7	56.5	54	4.2	78.1	50.9	64.5	83	14	42	29	...	1	...	...	...	...	...	...	...	...
Livingstone	3,051	60.7	56.5	53	4.2	82.0	52.8	67.4	88	15	47	1	9	...	...	...	66.7	914.3	883.0	912.7	3.2	...
Lusaka	4,193	63.8	57.5	53	6.6	75.1	54.9	65.0	82	14	49	28	...	2	...	...	...	877.5	882.8	...	4.1	...
Mazabuka	3,385	65.1	59.5	56	6.1	78.9	55.2	67.1	86	13	48	28	2	...	...	...	...	...	...	...	...	...
Mongu	3,481	66.9	59.0	53	8.3	84.2	57.8	71.0	91	16	49	29	15	...	...	...	...	898.9	881.7	...	2.2	...
Mpika	4,620	62.7	58.7	56	4.2	73.5	55.3	64.4	77	13	51	27	...	4	...	...	...	864.5	883.0	...	4.3	...
Mwinilunga	4,450	61.3	58.6	57	2.8	79.3	52.8	66.0	82	14	43	29	...	1	...	...	...	...	...	...	...	...
Ndola	4,190	62.5	58.2	55	4.4	78.5	53.8	66.1	84	13	48	18	...	...	...	...	...	877.4	882.4	...	3.3	...

Southern Rhodesia Veterinary Report.

MAY, 1939.

DISEASES.

African Coast Fever.—This disease was discovered on the farm Tweefontein, Salisbury district.

Trypanosomiasis was discovered on several farms along the Eastern Border in the Melsetter district.

TUBERCULIN TEST.

Twenty-four bulls and 46 cows were tested on importation and three re-actors were destroyed. Eighty-four head were tested locally at Bulawayo and doubtful re-actors are being re-tested.

MALLEIN TEST.

Seventeen horses were tested on importation and there were no re-actors.

IMPORTATIONS.

From the United Kingdom: 2 bulls, 9 cows.

From the Union of South Africa: 22 bulls, 37 cows, 17 horses, 1,050 sheep.

From the Bechuanaland Protectorate: 236 slaughter oxen, 700 sheep, 98 goats.

EXPORTATIONS.

To Union of South Africa: 154 oxen, 1 horse.

To Portuguese East Africa: 170 slaughter cattle, 72 sheep, 42 goats.

To Northern Rhodesia: 4 bulls, 4 cows.

EXPORTATIONS—MISCELLANEOUS.

To United Kingdom: Chilled beef quarters, 7,205; frozen beef quarters, 100; frozen boneless beef quarters, 908; pancreas, 139 lbs.; kidneys, 76 lbs.; tongues, 14,981 lbs.; livers, 19,075 lbs.; tails, 6,911 lbs.; skirts, 3,814 lbs.

To Northern Rhodesia: Nil.

To Belgian Congo: Beef carcases, 159½; mutton carcases, 25; offal, 211 lbs.

S. A. Myhill,
Chief Veterinary Surgeon.

SOUTHERN RHODESIA

Locust Invasion, 1932-39.

Monthly Report No. 78. May, 1939.

Movements of winged swarms of the Red Locust (*Nomadacris septemfasciata*, Serv.) have been reported in a few districts during the month, including Mtoko, Inyanga, Melsetter, Ndanga, Makoni, Hartley, Salisbury, Marandellas and Mrewa.

All these districts are situated in the eastern half of the Colony. Avery large swarm was reported by a native chief to have entered the Mtoko district from Portuguese East Africa during the third week of the month.

Serious damage to native crops was reported in the Makoni district.

RUPERT W. JACK,
Chief Entomologist.

THE RHODESIA

Agricultural Journal

Edited by the Director of Agriculture.

(Assisted by the Staff of the Agricultural Department).

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Editorial.

Contributions and correspondence regarding subjects affecting the farming industry of Southern Rhodesia are invited. All communications should be addressed to:—The Editor, Department of Agriculture, Salisbury. Correspondence regarding advertisements should be addressed:—The Art Printing Works, Ltd., Box 431, Salisbury.

Weeds and Grasses on Contour Ridges.—The Chief Entomologist points out that the presence of weeds, including grasses, which commonly flourish on disturbed soil has a marked influence on the prevalence of certain crop pests, as for example, the destructive *Snout Beetles* which attack maize, and *Maize Root Worm.* The presence of certain grasses is also liable to attract *Army Worm* moths to lay eggs in a dangerous position for subsequent migration to maize.

It would be of value to obtain some record of the species of grasses and other weeds which commonly take possession of contour ridges. This refers not only to the plants which appear during the first year after the furrow is constructed, but to the more or less permanent flora of the ridges.

This is an interesting and important subject and farmers are asked to submit specimens—in flower if possible—to the Botanist, Department of Agriculture, Box 387, Salisbury. It is anticipated that there will be considerable differences in the varieties of grasses and weeds in the different areas and on different soils. It is hoped, therefore, that as many farmers as possible will comply with the request and send in typical specimens from 1st year, 2nd year or older ridges giving the name of the farm, date ridges were made and type of soil.

Power Alcohol in Australia.—In the report of the Commonwealth Fuel Advisor as published in the International Sugar Journal, it is pointed out at the outset that under local conditions in Queensland the manufacture of alcohol for use as a substitute for petrol is uneconomical. It can be justified only by considerations of a national and social character, intended for use as an addition to petrol, say, in the proportion of 15 per cent.

At the present time the only firm preparing alcohol in the Commonwealth for this purpose is the Australian National Power Alcohol Co., whose distillery, having a capacity of 1¼ millions gallons per annum, is at Sarina. Its price for the power alcohol is 1s. 9d. per gallon, delivered into distributors' storage tanks. The oil companies are compelled to purchase 1½ gallons of this dehydrated alcohol per 100 gallons of petrol imported for consumption in Queensland.

It is blended in the proportion of 15:85 by volume, and sold at a price of ½d. per gallon less than the standard grades of petrol. To recoup themselves for the higher cost of alcohol, and the lower price of the blend, the oil companies have raised the price of petrol by ½d. per gallon. However, they do not try to extend their sales of alcohol and it is not even advertised to draw attention to such virtues as it possesses.

Even if the molasses from which the alcohol is produced costs nothing, and even if the excise duties were completely remitted, the distiller would not be able to produce and deliver power alcohol at a price competitive with the landed cost of imported petrol, which is about 1s. 1d. or 1s. 1½d. per gallon.

Summary of the Livestock Improvement Scheme.—The Livestock Improvement Scheme for the current financial year now provides for outright grants to approved applicants towards the purchase of improved bulls, and in addition loans for the payment of the balance of the purchase price in approved cases.

Briefly, grants and loans are made as follows:—

Grants.

1. A maximum sum of £15 up to 50% of the approved purchase price for bulls purchased in this Colony or elsewhere in South Africa. In special circumstances this grant may be increased to £25 in the case of high priced bulls purchased for high grade herds.

2. A maximum sum of £75 for bulls imported from overseas by established pedigree breeders.

3. Under ordinary conditions grants may only be made on a maximum of two bulls per individual, though provision is included for a larger number in the case of *bona fide* ranchers.

4. Under special circumstances grants up to half the above maximums may be made on pedigree female stock.

Loans.—In approved cases loans towards the balance of the purchase price may be made, these being repayable with interest at 5% per annum over a period of three years. Under ordinary conditions the maximum loan to any one breeder or partnership will be £50, though this may be increased to £100 in special circumstances.

Where desired the Livestock Improvement Committee will assist stock farmers in the selection and purchase of bulls.

Full particulars of the scheme are obtainable from the Secretary, Livestock Improvement Committee, Department of Agriculture and Lands, P.O. Box 387, Salisbury.

August Important in Cleanliness Campaign.—One month is about as important as another in a campaign of agricultural cleanliness aimed at insect control (and incidentally bringing

other benefits), but August has an importance of its own for the tobacco grower, as it heralds the approach of zero hour in the lives of some of his insect enemies. This is the month for policemen to ask awkward questions about tobacco re-growth and old stalks. It is also the month when pests of stored products are at their lowest ebb, nearly all being in the pupal or pre-pupal stage, preparing to emerge as the season's first generation of adults. Tobacco store-rooms and grading sheds and their surroundings should be at their cleanest during August to prevent the emergence of egg-laying adults and the presence of food for tobacco pests that may hatch later. The tobacco sales are over by the end of the month, which makes a final thorough cleaning-up all the more timely.

Legal requirements regarding the cleaning of tobacco lands and sheds are based on known protective and controlling effects of cleanliness.

The hygienic methods advised during the recent dry months for other branches of the farm should be continued.—Cleanliness Aids Insect Control.

A Note for the Housewife.—Now is the time to spring-clean your pantry and utilise, treat, or destroy all dried foodstuffs and other dried organic products that show evidence of infestation by insects. The insects of the pantry are the same as those that trouble the grocer, the pharmacist, the produce dealer, the tobacconist, and others. The adults will be due to emerge soon, and if they appear in larger numbers at the end of the year it will probably be due to negligence now.—Cleanliness Aids Insect Control.

Weed Eradication in Growing Crops.—What is said to be a simple and efficient method of eradicating troublesome weeds is reported in *Agriculture and Livestock in India*, by workers at the Indore Institute of Plant Industry. The method adopted was to cover, by means of a thick mulch of green material such as sunnhemp, green grass or even green weed growth removed from fields, the patches of land over-

grown with the particular weed desired to be destroyed, and allow the mulch to remain through the rainy season. At the end of this period it is found that the decomposing green material has acted on the root system of the weeds under the rotting cover green mantle and had effectively killed it. In addition to such destruction, the treated land is also said to have increased in fertility. Wheat and cotton grown on such treated plots gave significantly higher yields than the controls, and in the case of wheat, the quality also greatly improved. The improvement related mainly to the total nitrogen and gluten content, which were 2.07 and 11.53 per cent. respectively as against 1.65 and 8.04 per cent. in the control. The treated plots showed a higher content of organic matter in the upper zones of their soils than the controls, and it is surmised that the better quality of the wheat in the treated plots may be due to this increased organic matter content. The essential feature of the method is the use of green material as such in contradiction with dry material like straw, which was found to be ineffective.

Don't let your Wife Beat You.—The shining brass and highly polished furniture of your homestead reflect housewifely efficiency. Don't be beaten. A little reflection of your own will show how to obtain the same hygienic efficiency on the farm.—Cleanliness Aids Insect Control.

Trees and Wild Flowers.

ON THE RHODESIAN FARM.

By CHAS. K. BRAIN, M.A., D.Sc., Director of Agriculture.

PART VIII.

The Two Common Faureas. Family *Proteaceae*.—Two species of *Faurea* are common in the country, but are seldom found growing near to each other. *Faurea saligna* Harv. (Fig. 51) is most commonly found as a shrub or small tree up to 20 feet or so near water or on the fringe of vleis. This has narrow lanceolate leaves which are often tinged with red and flowers soon after the rains have set in. The flower spikes are usually 3 to 4 inches long and up to ½ inch in diameter. (Fig. 51a).

Faurea speciosa Welw. also occurs as a shrub or small tree, but in the tree form it is more rounded and denser than *saligna* (Fig. 52). It grows in the better drained or dry sandveld areas. Its leaves are longer and broader, reaching 6 inches long and 2 inches broad. Its flowers, which are in spikes up to 8 inches long and 1½ inches thick, appear usually from June to August. (Fig. 52a.)

The bark of both species has been used for tanning. The wood resembles beech and this accounts for the South African name "Beukenhout." It is occasionally used for making furniture, but is difficult to work. Posts of 7 or 8 inches diameter are good for farm buildings or fencing posts, as at this age the wood is durable and termite resistant.

Gomphrena Weed. *Gomphrena decumbens* Jacq. Family *Amarantaceae*.—This is one of the commonest weeds of waste lands and garden paths in the country. It is a native of Central America and has been spread to most parts of the world. The branches are at first prostrate and terminate in the stout white flower spikes which may reach an inch and a half in length. (Fig. 53.) The seeds are small, flattened,

Fig. 51.—*Faurea saligna* Harv. Prince Edward Dam, Salisbury

Fig. 51a.—*Faurea saligna* Harv. Flowering in January.

Fig 52.—*Faurea speciosa* Welw. Salisbury Commonage

Fig 52a.—*Faurea speciosa* Welw. Flowering in July.

Fig 53.—*Gomphrena decumbens* Jacq A common weed

Fig 54.—*Eriosema Engleri* Harms Salisbury Commonage. Flowering in July

Fig. 55.—*Haemanthus zambesiacus* Bak. Termite mound at six mile spruit Salisbury. Flowering November.

Fig. 56.—*Buphone disticha* Herb. Salisbury Commonage.

shining and reddish in colour. They are much sought after by certain kinds of garden ants which collect the half ripe seeds while enclosed in their white coverings and carry them underground to their nests. The empty white sheaths are later carried up and deposited around the entrance holes to the nest.

Another species of *Gomphrena* is sometimes grown in gardens. It is *G. globosa* Linn, the Bachelor's Button which has spherical, purplish flower heads an inch or more in diameter.

Eriosema Engleri Harms. Family *Leguminosae.*—This grey-leaved plant is one of the commonest so-called weeds of our commonages and pastures (Fig. 54). It increases rapidly where heavy grazing takes place. It is usually about 18 inches to 2 feet in height and appears to have three leaves arising from the same place. These are really three leaflets of the one compound leaf. Many of the flower stalks arise around the base of the plant from underground stems, but some are produced from the axils of the leaves. The flowers are pea-like and are deep yellow and brown. Although this plant does not seem to be eaten at all by cattle when growing it is relished by them when dried as hay. Owing to its high protein content when cut young it should be looked upon as a very valuable addition to hay paddocks.

Haemanthus and Buphone. Family *Amaryllidaceae.*—Two of our most conspicuous spring flowers are often confused. Both have their flowers in dense spherical umbels about as large as a small football. They may be separated by the following characters:—

Haemanthus zambesiacus Bak.	*Buphone disticha* Herb.
Usually grows on termite mounds.	Usually grows among stones.
Bulb below ground, white.	Bulb above ground covered with brown scales.
Leaves 2 only, broad, fleshy. (Fig. 55).	Leaves only appearing after flowers finished. Leaves flat numerous, from opposite sides (Fig. 56).
Flowers brilliant scarlet.	Flowers purplish or dark purplish red.

It should be noted that *Buphone* is poisonous to stock. The name *Buphone* means "ox-killer."

The Influence of Shelterbelts on areas adjacent to them.

The subject of forest influences is becoming so important nowadays in various parts of the world that the following summarised account of some Russian research on shelterbelt effects should be of interest.

One effect of shelterbelts is to diminish considerably the relatively high wind velocity in the dry regions. This is exemplified by data from the Kamenaja Steppe (Voronezh, Southern Russia), which showed that during the period 1918-28 in the protected fields under study the average wind velocity was decreased by about 30 per cent., and the average evaporation by about 35 per cent. as compared with the open steppe. The effect of shelterbelts is most pronounced on the lee side to a distance of 15 to 20 times, and on the windward side to a distance of 5 to 10 times their height. The higher the initial wind velocity in the open steppe, the greater is the retarding effect of shelterbelts. The extent to which the wind régime is modified depends also on the structure of the shelterbelts. Panfilov's investigations in Rotashev (Saratov, Southern Russia) revealed the following relationship between the structure of the shelterbelts examined and the average wind velocity (expressed as a percentage of the initial velocity in the open steppe) within their zone of influence on both leeward and windward sides.

Structure.	Average wind velocity per cent.
1. Shelterbelts "open" throughout their height (partly permeable to wind)	88
2. Shelterbelts "dense" throughout their height (impermeable to wind)	77
3. Shelterbelts of "medium density" (slightly permeable) below and "dense" above	69
4. Shelterbelts of "medium density" above and "open" below	73

A second effect of shelterbelts is the intensification of diurnal variations of temperature as shown by the observa-

tions of Vissotzky in Anatolia and of Bodrov in Rostashev. During the first half of the day while the heat content of the "active surface" is increasing the effect is positive, but from 3 p.m. onwards until after sunrise next morning a cooling effect is produced. It may be stated generally that, during the summer period, the effect of shelterbelts in either direction is the more pronounced according as the weather is hotter and drier, the solar radiation higher, and the daily range of temperature greater. During very hot and dry days the temperature of the zone adjacent to the shelterbelts may rise as much as 6 degrees above that of the open steppe, as was demonstrated by Bodrov's measurements with unprotected thermometers; and in such cases the danger of sun-scorch is increased by the presence of shelterbelts. On the other hand, though they lessen the probability of advective frosts shelterbelts, to some extent increase the likelihood of radiation frosts. Open shelterbelts intensify diurnal variations of temperature to a lesser degree than dense ones.

In the third place, as indicated by the data from the Kamenaja Steppe mentioned above, shelterbelts undoubtedly decrease evaporation from a free water surface, but the quantitative data obtained still lack precision, as the technique so far evolved for the investigation is in itself insufficiently accurate. Karusin's work at Timashev, north of Kuibishev, has, however, shown that shelterbelts do not produce any significant differences in the absolute moisture content of the air.

A further effect of shelterbelts, namely, their influence on soil moisture in areas intervening, was examined at all field stations and in particular detail at Timashev. The data at that station for 1932 and 1933 did not reveal any appreciable effect in the upper layers of the soil, but there was a significant difference in favour of the areas protected by shelterbelts in the deeper layers, 25-50 centimetres below ground level. At this depth there was an increase of moisture content by 3-4 per cent., and in some cases by 7-8 per cent., to a distance of 100 metres from the shelterbelts.

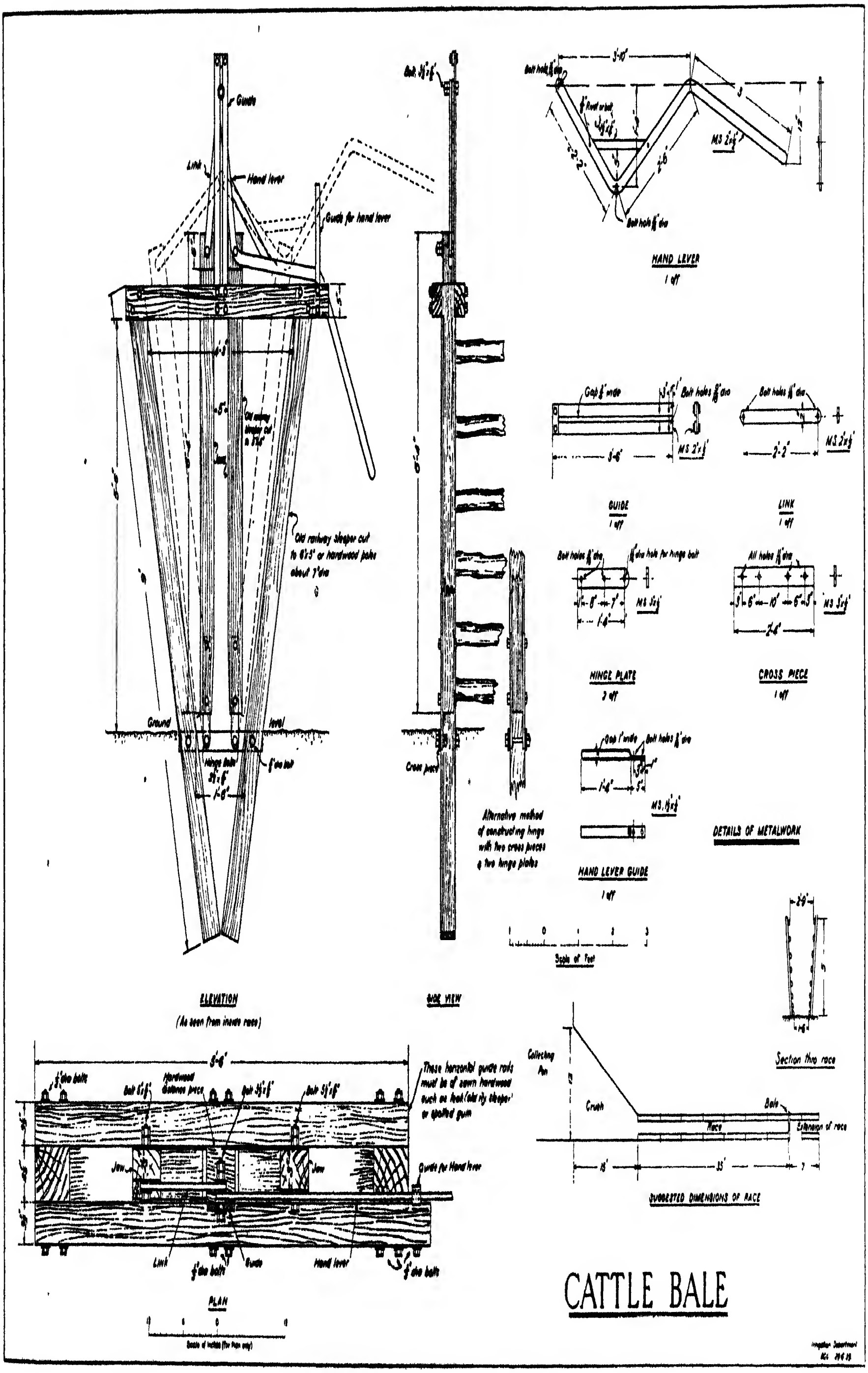
Finally, the effect of shelterbelts on fertility, as expressed in the yield of field crops, has been shown to be most pronounced in years of catastrophic drought and least marked

when weather conditions are favourable. This effect is subject to regional variation and also varies with different species and even varieties of field crops. The following table (from Sus.) will serve as an illustration. It shows the increase of yield due to shelterbelts expressed as a percentage of average yields from comparable fields without such shelter. The data represent rough averages for dry regions of Russia.

Percentage increase in yield under the influence of Shelterbelts.

Crops.	Favourable years.	Years of moderate drought.	Years of catastrophic drought.
Spring wheat	10-15	50-60	100-150
Winter wheat.....	15-20	80-100	400-500
Oats	5-10	50-60	100-150
Barley......	10-15	50-60	100-150
Sunflower.....	10-15	40-60	80-100
Lucerne	20-30	100-150	200-300
Rye......	15-20	80-100	150-200

In the drought year of 1933 it was found at Timashev that the field crops that benefited most from shelterbelt protection were the introduced, or less drought-resistant, varieties. In Guselsk (Saratov, Southern Russia), where a detailed study was made of the effect of shelterbelts on the yield of garden and industrial crops, it was found, *inter alia*, that shelterbelts 5-7 years old and 3-4 metres high planted at intervals of 125 to 250 metres apart made it possible to cultivate certain garden crops, including cucumbers and tomatoes, without irigation. According to Sokolov, the tomato crops protected by shelterbelts were far less affected by bacterial disease. Shelterbelts are also of very great importance in the protection of sub-tropical plantations. Thus, Dolidze reports that in Western Georgia, where the velocity of moist winds from the south-west and the dry winds from the east frequently attains 20 metres per second, they are the only effective means of preventing grave mechanical and also, in the case of east winds, physiological damage in tea plantations. In unprotected fields such damage often lowers the yield by over 75 per cent.—**Forestry Abstracts. Imperial Forestry Bureau.**


Guide
Link
Hand lever
Guide for hand lever
Old railway sleeper cut to 6"x5" or hardwood poles about 7" dia
Ground level
Hinge Bolt
Cross piece
Alternative method of constructing hinge with two cross pieces & two hinge plates
ELEVATION
(As seen from inside race)
SIDE VIEW
HAND LEVER
1 off
GUIDE
1 off
LINK
1 off
HINGE PLATE
2 off
CROSS PIECE
1 off
HAND LEVER GUIDE
1 off
DETAILS OF METALWORK
Scale of Feet
Section thro race
Collecting Pen
Crush
Race
Bale
Extension of race
SUGGESTED DIMENSIONS OF RACE
These horizontal guide rails must be of sawn hardwood such as teak (old rly sleeper) or spotted gum
Hardwood distance piece
Jaw
Guide for Hand lever
PLAN
Scale of Inches (for Plan only)
CATTLE BALE
Irrigation Department

Cattle Bale or Grip.

A cattle bale or grip is almost essential to handle cattle efficiently when carrying out such operations as dosing, inoculation, branding, castration, dehorning, the treatment of wounds, etc. The alternative in the case of the more serious of these operations is often to throw the cattle which is neither so speedy nor so hygienic.

The cattle grip at the Grassland Station, Marandellas, is in constant use and many farmers who have seen it have asked for plans from which to build it. It has, therefore, been decided to publish the explanatory diagram given here.

The construction of the bale is simple and comparatively inexpensive. It is not claimed that it is original, though there are new features in it we have not seen elsewhere. Several blacksmiths have already had experience in turning out the ironwork required. The ironwork for the one in use at the Grassland Station was turned out with a small hand forge on the farm.

In the drawing we show the uprights and jaws as made of railway sleepers, but any good native hardwood timber such as Mwanga, Mukwa, Knobthorn, Mopane could be used for these parts. The horizontal guide rails, however, should be made from hard timber, such as teak or spotted gum, sawn to their required shape. The hand lever is long enough to handle the ordinary run of cattle, but where wilder cattle have to be handled it is an advantage to make it longer. This can also be done by slipping an iron pipe over the end of the handle to lengthen it temporarily and give a greater leverage.

Soil and Water Conservation

PART III.

SOIL CONSERVATION AND FARMING.

CHAPTER VI.—GOOD FARMING AN ESSENTIAL PART OF SOIL CONSERVATION.

By D. Aylen and the Irrigation Officers.

Types of Erosion.—Erosion on cultivated land takes place in two main forms—

(1) Sheet erosion;

(2) Gully erosion.

Sheet erosion, as its name indicates, consists of a continual skimming off of the surface, a fraction of an inch at a time, and is therefore often not visible, a fact which leads many farmers into stating that they "lose nothing at all by erosion." Actually, sheet erosion occurs on practically every cultivated land, even though apparently flat, and is all the more dangerous for not being readily visible, with the result that the owner is made aware of his loss only by a gradual decline in crop yields. An inch of rain can carry off many tons of soil per acre, and this material contains a larger amount of the lighter elements, such as humus and soluble plant food, and the finer soil particles than an equivalent amount of soil in its original position.

The friability, resistance to erosion and absorptive capacity of a soil depends not only on its humus content but also on the size of its particles. The finest soil particles known as "colloidal clay" render a soil resistant to erosion, the higher their percentage the more resistant is the soil.

It is the presence of these particles which gives a muddy or cloudy appearance to flood water even after it has been standing for a sufficient time to permit of the settlement of the heavier particles of silt.

Due to erosion a soil deteriorates in texture as well as in depth and fertility, and an excessive amount of green-manuring and fertilising is then required to compensate for the losses.

Even although the muddy water formed by erosion contains an infinitely higher ratio of plant food to solid material than the soil in the land itself, the silt deposited at the foot of an eroded land will not as a rule grow good crops, because it consists mainly of sand and is deficient of potash, phosphates, nitrogen and other plant foods, as being soluble they are carried away.

Gully erosion is more spectacular and causes very heavy local losses through the spread of lateral branches, the area affected widens annually and lengthens as the head cut back into the land above, while the gully itself becomes deeper and wider. Many broad lands have been cut up and spoilt, and if protective measures are neglected too long the gullies eventually attain a size beyond reclamation, although they may be controlled by check-dams, bolsters, etc. If taken in time, however, they may be blocked and crossed by contour ridges. The longer a badly-gullied land is neglected, the more expensive it is to protect.

It is also seldom realised that if ridging is adopted to reclaim a badly gullied land further top soil works its way into the gullies until they become smoothed out. Of course, if the land were not contour-ridged all this and more soil would be *permanently* lost. Gully erosion will frequently develop from sheet erosion, through concentrated flow in any minor depression or channel.

Factors which Influence Erosion.—The rate of erosion is dependent on many factors, natural and artificial. Whilst the former cannot be altered their effect can to a great extent be overcome or controlled, and the latter should be adopted or avoided according as to whether their influence is for good or bad.

A farm which has natural disadvantages may be maintained in a good state by intelligent farming practice, whereas another, which is well favoured, may be ruined by mistaken methods.

Natural factors:—

(1) Rainfal intensity.

(2) Natural character of soil and sub-soil, including mechanical and chemical composition, texture, permeability, etc.

(3) Slope and contour of land.

Artificial factors:—

(1) Methods of working, such as ploughing, harrowing, planting, etc.

(2) Crops and rotations.

(3) Humus content (green-manuring, etc.).

(4) Selection and size of land. Soil conservation works.

(5) Effect of long continued cultivation on the soil structure.

Rainfall Intensity.—In temperate climates the rainfall is usually gentle and well distributed, but in sub-tropical countries, such as Southern Rhodesia, the rainfall is erratic and violent. Each year numerous small areas are subjected to purely local storms of very severe intensity. A rainfall of 3 inches in an hour must be regarded as of common, almost annual, occurrence anywhere, and storms reaching a rate of 6 to 8 inches per hour for a short period have been recorded. Every increase in the amount and intensity of rainfall causes a proportionately larger increase in the amount of run-off, and an increased volume of run-off means an increased velocity. If the velocity is doubled, the capacity of the water to transport soil is multiplied 64 times.

Character of the Soil.—The structure of a soil has a very great deal to do with its power to resist erosion and absorb moisture. In temperate climates the soil particles are lightly but sufficiently firmly cemented together to resist erosion and the particles are not tightly packed but held a little apart leaving minute spaces between the soil portions. The "cement" which binds the particles and causes a granulated or crumby structure is made up of soil colloids and humus.

Humus content is an all-important factor controlling soil structure as regards its friability, power of resistance to erosion, and its ability to absorb moisture. Lime has a similar effect on soil in this respect.

In such a climate as ours the building up of humus in the soil is a difficult matter, as the high temperatures and long dry season cause rapid destruction of the humus by oxidation.

Intensity of the rainfall and the lack of humus are the chief reasons for erosion being so rapid in this country and almost unknown under the conditions prevailing in England. Though on a poor sandy soil a light rain will be rapidly absorbed, the soil will be rapidly eroded during a violent storm due to the absence of binding material such as colloids and humus. Although a tightly packed clay soil is practically impervious, a clayey soil that is ideally granulated can absorb slowly and retain more moisture than a sandy soil.

It is obvious that the maintenance and improvement of the natural characteristics of a soil are of great importance, and it is not generally realised how great an improvement can be effected by "artificial" means, such as green-manuring and proper crop rotations.

Owing to the improvement effected in the soil there is less erosion from a land on which proper crop rotations have been practised during the seasons it is under a clean cultivated crop such as maize or tobacco than there would have been if there had been no crop rotation. It is obvious, therefore, that in addition to protective works such as contour ridges good farming should be practised if the full reward is to be reaped from soil conservation.

Good farming practice includes sound crop rotation, green-manuring, application of farmyard manure or compost, fertilising, contour working and last but not least, the cultivation of the soil so that it does not become either packed or puddled or pulverised to dust.

Slope and Contour of Land.—The two factors of the slope of a land and its extent materially affect is liability to erosion.

The degree of erosion can only be controlled if the land has a slope of more than 1 in 100 by the construction of protective works, and it is desirable in any event that the land should be sub-divided into blocks not more than 50 acres in extent.

Even in a generally flat land the erosion which occurs, due to the concentration of water in the minor depression or folds in the land, is often under-estimated and eventually results in the formation of gullies.

The larger of these depressions should not be ploughed but left protected by the natural vegetation and utilised for the disposal of storm water from the adjoining cultivated lands.

Improved pastures give the lowest soil losses and when not trampled the smallest water losses, but a bare land gives a very high rate of run-off and is very liable to erode.

The type of crop has an effect on the rate of erosion, and from this point of view they can be divided into groups—

(1) Clean cultivated row crops such as maize, sunflowers, tobacco, cotton, etc., which offer little resistance to erosion;

(2) Close low growing or broadcast crops, such as various beans and cowpeas, millet, green manure crops, oats, etc., which reduce erosion to a great extent.

Working of Lands.—Ploughing should be done when the soil is not more than just moist. Harrowing, cultivating and even hoeing should be avoided when it is wet.

It is well known that a soil that has been smoothed by excessive harrowing or by the movement of a sheet of water over the surface is not easily ploughed and, when ploughed, breaks into large hard clods which require excessive harrowings which have to be delayed until soaking rains have fallen and the soil is wet underneath.

Careless working of a soil is apt to damage the structure or friability by compacting it. Not only does this come about by actual pressure, but also each time a proportion of the small crumby fragments are pulverised and later when soaked form a more dense mass. Both the pulverisation and the

compaction reduce the power of the soil to resist erosion and absorb water. Depletion of humus and leaching of soluble and colloidal substances greatly assists the formation of an undesirable soil structure. These are, no doubt, the reasons why soil tends to become excessively cloddy, and yet after long soaking rains the clods may completely disperse to form a surface which is rather impervious and little resistant to erosion. Soils in such a state will in seasons of erratic rainfall give disappointingly low yields.

Most agricultural soils are in the best possible physical state when virgin. By careful working and systematic replacement of humus and fertilisers on an adequately contour-ridged land it should be possible to maintain the soil in its ideal state or to restore a depleted soil to a condition where it will return profitable yields.

It is clear, therefore, that in its fullest meaning the term soil conservation means a high standard of soil husbandry, and is the basic principal of lasting and economic agriculture.

Even if the land is not contour ridged all work should be done on the contour, in order that every little furrow may act as a miniature dam and not a drain, as occurs when downhill working is practised.

When opening new lands they should be selected and shaped with a view to future permanent and economical working and planning, and development should always be carried out with contour farming in mind. Water courses and vleis should not be broken up and natural hollows should be left at intervals in order to enable economical and convenient future disposal of surplus storm water.

Big gullies make farming more difficult than the most intensive system of protective works, and the utilisation of grassed waterways is not a lost asset, as the value of the grass from an improved pasture such as in a vlei may be higher than that of field crops planted on the same area. Areas with slopes of over 1 in 15 should not be farmed to field crops, as the number of crops that can be obtained before the land is ruined by erosion seldom pays the cost of stumping. In such cases protection is difficult and expensive and greatly increases the cost and difficulties of working. If such land

is finally abandoned owing to its failure to prove economical it must not be forgotten that an eroding area is a source of danger and damage to other lands, streams, underground water and dams.

CHAPTER VII.—WORKING OF PROTECTED LANDS.

In order that good crops can be grown over all of the strip between ridges, not only must the top soil be kept evenly spread, but as much rainwater as possible must be made to penetrate all over the area. Contour ridges assist this by enforcing contour working, as then every furrow or row is on the level and will hold up water. They collect the surplus water before sufficient has gathered to form a moving sheet, which would otherwise flatten the soil and perhaps form rivulets (or rills) which would, by causing miniature gullies, later permit drainage of surface water. In fact, their main advantage is that they permit maximum benefits to be reaped from good farming methods, such as deep ploughing, contour working, fertilising and manuring, maintenance of a rougish absorbent surface soil and crumby soil structure, and also to some extent prevent the spread of witchweed seed and the water-logging and silting up of lower lands caused by drainage into them from lands above. Gullies, even up to a size which ploughs could not cross, are checked and in a few years smoothed out. It will, however, take many years before good crops can be grown on the site of a previous gulley.

With high intensity rain the least soil and water losses would be from soil with a roughish surface and a loose crumby structure. The biggest soil loss from a dusty surface packed underneath and the biggest water loss from a smooth compacted surface.

If a dry lump of loam soil of ideal type for resistance to erosion, and having high capacity to absorb and retain water, generally because of high humus content, is examined, it will be seen to have numerous small holes in it. It will break relatively easily into small fragments with little or no dust or separate particles, and if gently immersed in water and not disturbed will not eventually flatten right down to a layer of mud but crumble into small fragments which retain their shape.

When a soil which naturally has little resistance to erosion or one which has been maltreated by over-cropping, excessive working when too wet and failure to replace humus is examined, it will be found that the clods are hard and entirely free from small holes; when broken considerable dust is found and a small piece, however carefully immersed in water, will rapidly collapse and separate entirely into individual grains of sand and mud.

A heavy storm readily converts a dusty mulch-like surface to a smooth relatively impervious one as the rain drops beat down and compact the surface by readily moving the loose grains and dissolving the finer soil particles (clay). The muddy water so formed seals the pores of the surface, which now will not only give an unduly large run-off but may also have a high rate of evaporation. A cultivation at this stage makes the surface more receptive to the next rain and may reduce evaporation but exposes damp soil and definitely further compacts the soil structure just below the surface.

When heavy rain first falls on a loose dusty surface such as is formed by repeated harrowings or cultivations the early part of the rain is all absorbed, then comes a period when run-off commences and the proportion of soil in the water is high, finally when really soaked the surface becomes smooth and packed, and though run-off increases the proportion of soil decreases.

The resultant smooth and packed surface is in the least favourable soil condition for both resistance to erosion and power to absorb rain water, and with the next heavy rain soil and water losses are high. This undesirable condition could only be remedied by a harrowing or cultivation between each heavy storm, and such excessive working would result in serious packing of the soil below and further pulverisation of the surface.

The soil and water losses from a soil with a rough surface are certainly not greater than from a carefully cultivated one which has become compacted below the surface and after a heavy storm the surface is in a very similar state as before. It is ready to resist and absorb the next shower.

Soils which have become compacted have a reduced capacity to retain moisture and so are more prone to water-logging during rainy periods and also rapid dying out during a drought. The limitation of the amount of air held in this soil restricts bacterial action and the hardness and tendency to crack restricts and damages root growth.

Only when soil conditions are ideal will the passage of animals and implements over the land do little damage to the soil structure. It is, therefore, important to keep mechanical operations to a minimum and endeavour to undertake them only when the soil is best suited and to avoid complete pulverisation as well as the formation of hard clods. Once the soil has been poached by working when too wet it takes many years of careful management before ploughing and harrowing become easy again.

These are the reasons why from a soil and water conservation point of view it is recommended to have the land in as rough a condition as is reasonably possible and to restrict mechanical operations to the minimum necessary for control of weeds.

Weeds should be destroyed before they attain any size, as they use up huge quantities of water and the repeated deep cultivation necessary to kill big weeds packs the soil.

In semi-arid districts wider than normal spacing of crops will give better yields, and maize, for example, may be planted in alternate strips with a crop such as cowpeas or soya beans which is not so exacting on the moisture. This system has several other advantages, the inter-planted crop enriches the soil and also causes more rain water to penetrate during that and the following season.

Contour ridges alone can cause a slight improvement in crop yields due to the effect of the change over to contour working increasing the absorption of rainfall, but without good farming methods as well high yields will not be attained nor will the ridges prove permanently satisfactory. The benefits of correctly designed and maintained contour ridges are more apparent in abnormally wet or dry years than in normal seasons, because in a dry season with periods of heavy

rain with long intervals of drought between, far more rain water will be absorbed and held to tide over the drought periods in a contour worked land, not only as a direct result of the contour working but also as an indirect result, as contour ridging is responsible for maximum benefits being derived from good farming practices and so brings about more favourable soil conditions than possible on an eroding land, however well it is otherwise worked.

Plants will suffer less in a wet season on a well worked land due to the more favourable soil conditions and surplus water will be intercepted and drained off at regular intervals in any correctly designed, made and worked system of contour ridges. This water would otherwise flatten, leach and erode the land, and moreover by drainage towards lower and flatter slopes cause water-logging there.

Planting of Contour-ridged Land and Contour Ridges.—Contour-ridged land should be contour planted, except in the case where the crop rows are ridged-up on a previously gullied land which has not yet smoothed out, as in that case the rows will concentrate water in the old gullies, causing erosion and endangering the contour ridge by the rush of water and deposit of silt. In such a case hillocks are better than ridged crop-rows.

The usual practice when planting a contour ridged land is to start by running the rows on top of or just below the ridge bank. Subsequent rows are made below the previous one. This system has several advantages over the other alternative method of starting just above the channel and making each row above the last, as in the first method the upper rows which is the area where water conservation is the most important are most nearly on the contour, and the lower rows or short rows all drain into the channel. Turning of cultivators and planters within the land is done in the only lost space, *viz.*, in the channel. With the other method the short rows end on the lower side of the bank and form downhill loops which concentrate water. These rows eventually break in the centre, causing a wash down to the lower contour ridge.

On many tobacco lands drainage is of primary importance. Provided that the land is not gullied the rows may be run at an angle to the contour ridges. This angle varies according to the slope, and on very gently sloping land with close spaced ridges may be straight up and down the slope. This practice must not be adopted on any but the gentlest slopes and closest spacings of contour ridges, as otherwise so much silt is deposited in the channel as to first block it and cause water-logging and later breakages. Diagonal rows should be marked off so that the slope is about 1/50 to 1/100. Usually a diagonal furrow is made near the centre of the strip and subsequent rows are made parallel to this on either side until the land is completed.

(To be continued.)

Cleanliness Aids Insect Control.

Report of the Branch of Plant Pathology.

FOR THE YEAR ENDING 31ST DECEMBER, 1938.

By J. C. F. Hopkins, D.Sc. (London), A.I.C.T.A., Senior Plant Pathologist.

Movements.—Visits have been paid to 144 farms in the following districts: Lomagundi, Umvukwes, Trelawney, Sinoia, Mazoe, Marandellas, Makoni, Inyanga, Umtali, Melsetter, Chipinga and Salisbury. Two inspections were made at the Sub-Tropical Experimental Station, Umtali, and a visit was paid to the Tobacco Research Station, Trelawney, to discuss tobacco disease problems.

Ten inspections were made of tobacco at the auction floors and warehouses, eight of fruit at the Salisbury Station and in the city stores, and four of nurseries in Salisbury, Umtali and Bulawayo.

Addresses were given to Farmers' Association meetings at Umtali and in the Ayrshire-Sipolilo district.

The Senior Plant Pathologist travelled to Pretoria to enquire into the progress being made with subsidised research into diseases of maize and to draw up further pojects for 1939.

ROUTINE.

Herbarium.—Further work has been done in determining unnamed material in the Eyles Collection, which was taken over by this Branch and reported upon last year. A good deal of undetermined material which had accumulated in the herbarium during the past five or six years was also re-sorted and examined, and selected specimens from both sources sent to the Imperial Mycological Institute and the Department of Agriculture, Pretoria, for determination. Most of this material has now been reported upon and a number of fungi declared to be new species.

All records up to the end of 1937, including those of the late Mr. Eyles, have been brought together, the entries checked in the host and systematic card indexes and incorporated in the first list of Rhodesian fungi, which was published during the year. The list includes 430 species of fungi, their distribution and bibliographical references to original descriptions. Six new species are described with Latin diagnoses.

A scarcity of records of certain large groups of fungi, especially the *Sphaeriales* and *Agaricaceae*, is revealed and is regretted, but is due to the fact that systematic work on the indigenous fungus flora has always had to give way to the demands of routine duties connected with agricultural crops. The need for a more representative mycological herbarium is apparent, but cannot be supplied until additional staft is available for herbarium work.

As a result of the publication of the "list," numerous requests for specimens have been received from mycologists in Africa and overseas.

The amount of material distributed and received in exchange has in the past been small, but increased last year and is now dealt with as a definite part of the routine duties of this laboratory.

Owing to duties in other directions recorded in this report, the revised and annotated list of plant diseases, which it was desired to publish in conjunction with the list of fungi, has not been completed.

Publications.—The following papers were published during the year:—

In the *Transactions of the Rhodesia Scientific Association*—

1. "A Fruit Rot of pawpaw caused by *Phoma caricina* n.sp."

2. "A Preliminary List of Rhodesian Fungi."

In the *Rhodesia Agricultural Journal*—

3. "Common Diseases of Apples and their Control in Southern Rhodesia." June issue.

4. "A Note on a Stem Rot of Sweet Peas." June issue.

5. "Seasonal Notes on Tobacco Diseases 11. Two Destructive Curing Moulds." July issue.
6. "Annual Report of the Branch of Plant Pathology." August issue.
7. "The Spraying of Tobacco Seed-beds and Control of Rosette Disease"; jointly with Mr. M. C. Mossop. October issue.

The Departmental Handbook on diseases of tobacco was brought up to date by a supplement which was prepared for publication in January, 1939.

A talk was given to the Rotary Club on the economic aspects of apple diseases and an inaugural lecture on fungi delivered to the Salisbury Public School Science Society at the invitation of the headmaster.

Legislation and Plant Inspection.—Sixty-three examinations were made in the laboratory of imported plant material. A feature of this year's plant inspection was the high percentage of diseased tubers found in some lots of potato "seed" imported from the Union. Black scurf (*Corticium Solani*), powdery scab (*Spongospora subterranea*), common scab (*Actinomyces* spp.) and *Fusarium* rots were so prevalent in some consignments as to warrant their rejection. Infection of imported Scotch "seed" by powdery scab also appears to have increased.

Four nursery inspections were carried out, ten visits paid to tobacco auction floors and warehouses and eight examinations made of fruit at the Salisbury Railway Station and in the city stores.

Laboratory.—Five hundred and ninety-three lots of material have been dealt with during the year. This is an increase of 425, or more than three times that received in 1937, and exceeds the maximum received in any previous year by nearly 200.

This increase is partly due to the acquisition of 220 specimens belonging to the Eyles collection. These specimens were, however, checked with the Eyles record books, stored

in glass topped boxes and provided with herbarium labels. A new bench fitted with drawers has been obtained for the suitable accommodation of macro-forms and woody specimens.

Of the remaining 371 specimens, 41 are diseases newly recorded in the Colony. They are:—*Eutypella stellulata*, *Fracchiaea heterogenea*, *Fumago vagans*, *Botryosphaeria ribis chromogena* and *Alternaria mali* on apple; *Phytophthora parasitica* on Japanese lily; *Phoma destructiva*, probably American "streak" virus, and *Alternaria Solani* on tomato; *Pythium aphanidermatum*, chlorine injury, *Fusarium scirpi* var. *acuminatum*, and *Rhizopus arrhizus* on tobacco; *Glomerella cingulata* on granadilla and *Solanum incanum; Botryosphaeria ribis chromogena* on avocado and guava; *Botrytis cineria* on grapes; *Fusarium solani* var *martii* on sweet pea; *Bacterium tumefaciens* on peach; *Rhizopus nigricans* on avocado; *Alternaria brassicae* on cabbage and cauliflower; yellow edge (virus) on strawberry; *Mycosphaerella theae* on tea; *Rhizoctonia solani* head rot of lettuce; Tobacco Rosette (virus) on *Solanum nigrum; Ravenelia escharoides* on *Acacia mocambicensis; Parodiella perisporioides* on *Eriosema Engleri; Papularia sphaerosperma* on *Phragmites; Physarum vernum* on lawn grass; *Aecidium* spp. on *Temnocalyx* and *Barleria; Coniophora cerebella* on dry rot of timber; *Trametes roseola* on live peach; *Poria radula* on decaying timber; *Uredo Kaempferiae* on *Kaempferia indica; Ceuthocarpum* n.sp. on *Ochna;* and *Cercospora* n.sp. on *Gymnosporia senegalensis*.

Apart from the new records and new species of fungi encountered, a very large number of specimens sent in has included a wide range of agricultural and ornamental plants which have been quite beyond the powers of this branch to deal with. As it was, the investigational work commenced at the beginning of the year was interrupted so frequently by the demands of routine examination that most of the research projects had to be discontinued. Even so, fifty-eight diseased specimens were obliged to be discarded and no report was made upon them. These included diseases of economic plants, some of which were apparently very destructive, for example wilting of maize plants associated with a stem fungus, a fruit disease of granadillas, wilt of potatoes resembling tobacco Granville wilt, suspected ergot of rye, wilt of

pyrethrum, browning of caulifiers, several apple diseases, die-back of peach, "little leaf" of peach and grapes, foot rot of wheat and so on. The position has now been reached that even with the help of the Professional Assistant, time cannot be found for the isolation and cultivation of organisms responsible for diseases which are not readily recognisable. In other words, the present staff is unable to cope with the normal laboratory duties imposed upon it.

Propaganda.—Apart from the publications and lectures already referred to, the demands of the laboratory have made it impossible to give attention to organised propaganda. Tentative arrangements had been made to place an exhibit on several agricultural shows, but the scheme had to be cancelled. The usual exhibit was, however, put on the Salisbury Agricultural Show.

Coloured photographs were prepared for use at farmers' meetings, and a number of samples of new fungicides distributed to interested growers.

Three days were devoted to demonstrations of botany and plant pathology to teachers attending a vacation course.

RESEARCH.

Apples.—The principal investigation has been a general survey of apple diseases in the Colony. This work was commenced last year when spraying experiments were initiated.

The more common diseases known to occur in apple growing countries have been found in the Colony, but the most troublesome appear to be mildew, fruit cracking and canker (*Botryosphaeria ribis chromogena*). Special attention was given to the host range and etiology of the canker fungus, which has been found to cause extensive damage to both avocado and guava trees. Cross-inoculations from apple and avocado branches to apple and avocado fruit gave positive results.

A study of fruit cracking, more particularly in the Ohinemuri (Dunn's Seedling) and Jonathan varieties was commenced. Although this disease is generally attributed to infection by *Coniothecium chomatosporum*, it has been found that the fungus is not invariably present in affected Rhodesian

fruit. A fuller investigation of the disease was commenced, but had to be discontinued owing to the demands of routine work. No positive results were obtained from spraying trials against cracking.

The spraying experiments started last year were continued and extended.

A preliminary survey was made of fungi causing breakdown of fruit in storage. The more common rots found in fresh fruit exposed for sale were shown to have originated in the orchards. Bitter rot (*Glomerella cingulata*) and canker rot (*Botryosphaeria ribis chromogena*) were prevalent, the latter causing a disagreeable wet breakdown which resulted in numerous samples being condemned as unfit for sale.

Boxes of fruit kept in the laboratory and examined periodically were affected in a similar manner, the bulk of the breakdown being caused by *Botryosphaeria*.

Following up these findings ,a large number of trees was examined in different parts of the Colony, and a high percentage of canker on branches and trunks was found to exist.

Experimental boxes of fruit kept in cold storage by a commercial firm were examined after six months. The condition of all the fruit was poor, between 25 and 40 per cent. having broken down as a result of infection by *Penicillium expansum*. The possibility of successful storage for several months with the facilities and knowledge of conditions at present available appears to be remote.

Vegetables.—A further selection of peas was made for mildew resistance. Two types, a bush and a tall, have been retained, both of which produce large sized pods and peas of good flavour and cooking qualities. Only one generation was raised during the year.

A small quantity of beans resistant to "halo blight" (*Bacterium medicaginis* var. *phaseolicola*) were grown and selected seed distributed to some growers for trial.

Tobacco.—The threatening danger from rosette disease and the urgent need for data on which to base control measures made it necessary to undertake some small investigations.

The work of Wickens at Trelawney on the transmission of the virus by the aphis *Myzus persicae* was confirmed, whilst investigations in the field showed that the disease could be present in seed-beds.

Experiments were also made in co-operation with the branch of Entomology, with spray fluids for the control of aphids, and recommendations based on the results obtained were published in the *Rhodesia Agricultural Journal*.

A localised leaf chlorosis, apparently due to a virus, was studied. The disease was not identified, but appeared to be transmitted by *Myzus persicae*. No time was available for a fuller investigation.

Strawberries.—The virus disease reported last year has been definitely identified by Mr. R. V. Harris, at East Malling, as "severe crinkle." During the year a second degeneration disease was seen at Umtali and in other parts of the Colony. It has all the symptoms of "yellow edge" and may occur alone or combined with "severe crinkle." The presence of these two diseases accounts for the rapid degeneration of straberry stocks, but the insect vector, which presumably exists, has not yet been found.

CROPS.

Tobacco.—The 1937-38 season was noteworthy for the almost complete absence of diseases in the seed-beds. Despite this happy condition, however, the usual diseases made their appearance in the lands later in the season. Two weeks of very wet weather at the beginning of 1938 proved favourable to the development of wildfire (*Bacterium tabacum*) and primary infection by frog eye (*Cercospora nicotianae*) and brown spot (*Alternaria longipes*). On a number of farms wildfire threatened to do much damage, and in some cases rather heavy losses were sustained, but in other cases control measures were promptly applied and the disease kept within reasonable bounds. Considerable success in this direction has been obtained by spraying in the field from knapsack pumps, which is the most convenient form of application as yet tested in Rhodesia. The method is evidently becoming more popular amongst growers, because merchants report a great increase in orders for knapsack spray pumps.

The sudden cessation of rains early in the year checked the development of brown spot to some extent, although the leaf put up for sale on the auction floors was often affected by this disease.

Frog eye barn spot was also much in evidence despite the dry weather at reaping time. Evidently the high prices which were paid for spotted and perished tobacco encouraged growers to reduce the number of leaves primed in an endeavour to obtain as heavy a crop as possible, irrespective of grades. The natural effect of this would be an abundant production of fungus spores on the frog eye spots in the field with an excessive amount of barn spotting developing as a consequence.

Overcrowding of barns was also responsible for unusually high losses from barn rot (*Rhizopus arrhizus*) and yellow mould (*Aspergillus flavus*).

A considerable increase has taken place in the number of outbreaks of wildfire reported during the year. A good number of these have been traced to planting on infected "second year" land, or in lands adjoining those which had carried an infected crop in the previous year. Extended acreages planted to tobacco and consequent lack of land for rotation crops necessitates the utilisation of infected fields.

Two other noteworthy diseases have attracted attention, namely, the new "rosette," caused by an aphis-transmitted virus, and black stem rot, due to a fungus apparently identical with *Pythium aphanidermatum*. No reports of very extensive damage by either of these diseases has been received, but the potentialities of rosette are enormous.

Black stem rot infection killed many young plants put out under somewhat unfavourable conditions. In a few cases, whole lands had to be replanted. In the seed-beds it caused a rather persistent damping-off during wet weather, but was successfully controlled by sprinkling affected patches with dry Bordeaux powder or watering with Cheshunt Compound.

Apples.—An increased number of enquiries have been received regarding spray schedules, and growers are making attempts to clean trees of infected wood.

Fruit is marketed in poor condition and does not keep well as a result of fungus infection. Fuller details of the general position are given above under "Research."

It is unfortunate that many growers do not yet understand the relationship between fungous diseases and financial losses resulting from poor keeping qualities of fruit.

Other Fruits.—The degeneration diseases of strawberries have so reduced the quality and quantity of fruit marketed in the larger towns that it is now difficult to obtain regular supplies of good flavoured produce.

Arrangements have been made for the importation of virus-free "Royal Sovereign" runners, and growers have been advised in regard to selection and roguing.

Maize.—There has been an increase in the amount of "diplodia" infected grain being sold as seed. The reason for this is not clear, as reports of heavy infection by ear rotting fungi have not been received.

Merchants report a steady increase in the sales of seed disinfectants.

Other Crops.—Nothing of outstanding importance has been recorded with the exception, perhaps, of *Armillaria mellea* root rot of tea. Sporadic outbreaks of this disease continue to occur despite the removal of bushes and roots.

A somewhat wider range of horticultural and agricultural crop diseases has been dealt with this year, details of which are given under "Routine—Laboratory."

Miscellaneous.—Assistance in various ways has been given to the Chief Chemist, the Chief Entomologist, the Manager, Salisbury Experiment Station, Messrs. Bayer, Messrs. Cooper and Nephews, and Messrs. Fison.

BOTANY.

In addition to her professional and clerical duties in the Branch of Plant Pathology, the Professional Assistant has also devoted considerable time to the botanical herbarium.

Report of the Division of Entomology.

FOR THE YEAR ENDING 31st DECEMBER, 1938.

By J. K. Chorley, Acting Chief Entomologist.

AGRICULTURAL.

1. **Locusts.**—The Colony continued to be infested with the Red Locust (*Nomadacris septemfasciata*, Serv.) during the year, although not as seriously as at the commencement of the invasion. Egg-laying commenced in December, 1937, and became general during January. The destruction of hoppers was carried out mainly for the protection of crops in all accessible areas, and although a few individual farmers suffered loss, no serious general damage to crops occurred. By April most of those hoppers which had escaped destruction had matured.

In portions of the Zambesi Valley, in which it was difficult to organise the destruction of hoppers owing to the sparse population and inaccessibility, considerable damage resulted to native crops, principally kaffir corn and maize, by the resulting flying swarms. Drought conditions intensified the position. Famine conditions prevailed in localised areas and the native population temporarily migrated to the Zambesi River, where early crops can be produced on the river banks.

During the winter and summer months the Eastern Districts suffered from continual invasions of flying swarms from Portuguese East Africa, while some swarms, presumably originating in the Colony, invaded the Northern Transvaal and the Bechuanaland Protectorate during October.

Egg-laying commenced in December, slightly earlier than in the previous season, and the first hoppers appeared at the end of December. It is not expected that a serious and wide-

spread infestation of hoppers will occur and no heavy expenditure on combatting hoppers is likely to be necessary during the coming season.

Locust birds, particularly storks and kites, have been very numerous and have been associated with most of the flying swarms.

Experiments with poisoned bait were only partially successful, and the Department continues to rely on spraying, at least for the present.

It was not possible to send a delegate to the International Locust Conference, held in Brussels during August, and to date the scheme for international locust control at the permanent breeding grounds of the Red Locust has not matured.

Financial assistance to the Locust Advisory Committee of the Imperial Economic Council has been continued.

2. **Pests of Growing Maize.**—Stalk-borer (*Busseola fusca*, Hmps.) was reported as a serious pest of the maize crop in the Shamva district. Outbreaks of Army Worm (*Laphygma exempta*, Walk.) occurred during early January in the Hartley, Mazoe, Lomagundi and Bulawayo districts. In the Mazoe district storks were reported to have eradicated Army Worm on two farms. A ladybird beetle, *Epilachna similis*, Thb., damaged the leaves of seedling maize and wintersome, a fodder crop, during January in the Wankie district. The snout beetles, *Tanymecus destructor*, Mshl., and *Systates exaptus*, Mshl., caused extensive damage during December to seedlings in the Salisbury, Hartley and Mazoe districts. *Tanymecus rapax*, Mshl., severely injured seedling maize in a vlei in the Hartley district during early December. Poison-baiting was carried out on several farms against snout beetles in maize lands. White grubs, the larvae of the chafer beetle, *Eulepida mashona*, Arrow, caused some damage to the roots of large plants during April and May in the Salisbury district. Caterpillar of the Maize Ear Worm, *Cirphis loreyi*, Dup., caused some damage to plants at the time of cobbing during March in the Gwelo district.

3. **Pests of Growing Tobacco.**—Root Gallworn (*Heterodera marioni*, Goodey) continues to be a serious pest of tobacco both

in seed-beds and in the field. An officer of the Tobacco Research Station at Trelawney is at present engaged in investigating problems of the control and eradication of this pest. No serious outbreaks of the Tobacco White-Fly (*Bemisia rhodesiaensis*, Corb.) were reported during the year, the few small occurrences being of a purely local nature.

Tobacco Aphis or Green Fly (*Myzus* (*Aphis*) *persicae*, Sulz.) increased alarmingly on some farms during January in the Makoni district. The origin of the outbreak could not be traced and no explanation for the rapid increase of this pest can be given. It is believed that slightly infested seed-beds were the sources. This pest is regarded as a serious menace to the tobacco industry in view of the discovery that it is a vector of the virus disease, Tobacco Rosette. As a tentative measure, growers were advised to include nicotine extract in the seed-bed sprays, although it was recognised that thorough spraying of closely growing seedlings is a rather difficult operation; if carried out, thoroughness is necessary if the spray is to be effective.

Two species of ants, *Pheidole liengmei*, For., race *micrartifex*, For., and *Tetramorium setuliferum*, Em., carried off seed from tobacco seed-beds during October and November in Lomagundi and Salisbury districts.

(*a*) **Other Pests of Tobacco.**—Sand crickets (*Brachytrypes membranaceus*, Dr.) caused some damage to plants in the fields in December in the Salisbury district. Leaf-miner (*Phthorimaea operculella*, Zell.) and stem-borer (*P. heliopa*, Lw.) were present as minor pests in several districts, but in one locality near Salisbury a report of extensive damage in mid-December was received. White grubs (*Eulepida mashona*, Arrow) and wireworms (*Trachynotus* sp. and *Psammodes* sp.) attacked the roots of newly transplanted tobacco in the Salisbury South area. A small beetle, *Analeurops* sp., caused much injury to the leaves of plants in seed-beds in November in the Marandellas district. No serious outbreaks of cutworms (*Euxoa segetum*, Schiff.) were reported during the year.

4. **Pests of Leguminous Crops.**—The most serious pest of sunn hemp (*Crotalaria*) was the leaf-eating beetle, *Exora discoidalis*, Jac., which emerged in great numbers with the

first heavy rains and attacked the seedlings in early December. Large areas in the Salisbury, Marandellas, Mazoe and Shamva districts had to be re-sown as a result of mass infestation. Crops sown late in December largely escaped injury. Cowpeas (*Vigna*) and soya beans (*Glycine*) were defoliated by the beetle, *Ootheca mutabilis*, Sahlb., in late December in the Salisbury district. Dolichos beans (*Dolichos lablab*) in the Marandellas and Salisbury districts were heavily infested by American bollworms (*Heliothis armigera*, Hubn.=*obsoleta*, F.) during March and April.

5. **Pests of Cereal Crops.**—Some damage to barley by aphids or green fly (*Toxoptera graminum*, Rond.) during June was reported from the Umtali district. Grasshoppers damaged wheat during July in the Mazoe district.

6. **Pests of Cotton.**—Generally speaking, the cotton crop throughout the Colony has suffered only comparatively mild attacks of insects, and the result was seen in the high proportion of clean white cotton passing through the Bindura Ginnery.

Jassid (*Empoasca facialis*, Jac.) at the Gatooma Research Station was noted as damaging Bancroft and the less resistant (less hairy) strains of U.4 in proportion to their lack of resistance. Aphis (*A. gossypii*, Glov.) was troublesome during the drought period in February and March. Infestation of cotton by American Bollworm (*Heliothis armigera*, Hubn.) was less than in many previous years. American Bollworm is the most important pest of cotton, and for this reason it is being closely studied at Gatooma. Experiments with trap crops such a *Dolichos*, *Poona lubia*, gram and other plants which may attract egg-laying moths away from cotton are being carried out. Moths oviposited markely on month-old cotton plants in January, and slightly on young plants in February and March. The peak of egg-laying was reached in April. The policy of prohibiting ratooning was shown to be highly beneficial. Cotton Stainers (*Dysdercus* spp.) did slight injury to the crop throughout the Colony, possibly as a result of the prohibition of ratooning. Experiments in trapping stainers by means of cotton seed traps have been carried out. There appears to be a small advantage gained from trapping

adults early in the season, but marked results were obtained in trapping nymphs.

The above notes have been abstracted from a report kindly provided by Major G. S. Cameron, Cotton Specialist.

7. **Pests of Citrus.**—The outstanding feature of the year was the extremely mild infestation of American Bollworm (*Heliothis armigera*, Hubn.). It is possible that this mild infestation may be attributed to the unusually warm conditions experienced during the early part of the winter which caused a proportion of the over-wintering pupae to develop much earlier than usual. The Citrus Aphis (*A. tavaresi*, del G.) and the Citrus Thrips (*Scirtothrips aurantii*, Fauré) were of little importance, and the usual control measures, *i.e.*, spraying with lime sulphur and nicotine, were satisfactory. It should be noted that infestation of citrus fruits by the False Codling Moth (*Argyroploce leucotreta*, Meyr.) was heavier than in former years. At present this moth is a minor pest, but it is one which will need to be kept under close observation. At the Premier Estate, near Umtali, during last October and early November, the citrus trees, especially grape fruit trees, were damaged by several large swarms of Red Locusts.

The above notes were kindly supplied by Dr. W. J. Hall, Director of the Citrus Experiment Station, Mazoe.

8. **Pests of Fruit other than Citrus.**—Some damage to the foliage and blossom of apple trees by chafer beetles, *Adoretus tessulatus*, Burm., and *Anomala exitialis*, Pér., was reported from the Salisbury and Marandellas districts in October and November Two species of termites or White Ants, *Ancistrotermes crucifer*, Sjöst., and *Termes pauperans*, Silv., were reported injuring the bark and roots of newly-planted deciduous fruit trees in July near Salisbury. Caterpillars of the moth, *Parasa latistriga*, Walk., defoliated plum trees during June and July in the Marandellas district. The caterpillars were heavily parasitized by an Ichneumon, *Oneilella*, sp., and a Chrysid wasp, *Pentachrysis bombycida*, Mocs. A further spread of the Mango Scale, *Aulacaspis cinnamomi*, Newst., was observed in the city of Salisbury. The fruit fly, *Ceratitis capitata*, Wied., was a minor pest of peaches in November in Salisbury.

9. **Pests of Vegetables and Garden Plants.**— Bagrada bug (*B. hilaris*, Burm.) was not much in evidence as a pest during the year. In the Inyanga and Gwelo districts during July and October some damage to cruciferous crops by the diamond-back moth (*Plutella maculipennis*, Curt.) was reported. Sweet peas were attacked by the pea aphid (*Macrosiphon pisi*, Kalt.) in May and June in Salisbury. Tomato plants were injured by a mite, *Eriophyes* sp., in October in Salisbury. Caterpillars of the moth *Bracharoa bistigmera*, Butl., injured the leaves of Barberton Daisy in April in the Salisbury district. Globe Artichokes were severely attacked by an aphid, *Macrosiphon compositae*, Theo., during January in Salisbury.

Damage to the flowers of aloes by a weevil, *Brachycerus interstitalis*, Pér., was reported from the Mazoe district. Clarkia plants were attacked by a root-infesting Coccid, *Margarodes*, sp., in August in Salisbury. Liliaceous and Amaryllidaceous plants were damaged by the weevil *Brachycerus congestus*, Gerst., in October, November and December in the Salisbury district.

10. **Pests of Stored Products.**—(*a*) *Tobacco.*—Owing to the generally accepted necessity for cleanliness in farm sheds and in warehouses, now recognised as a result of the educational propaganda of this Division, the satisfactory position as regards the Stored Tobacco Worm, *Ephestia elutella*, Hubn., and the Tobacco Beetle, *Lasioderma serricorne*, F., has been maintained. Local outbreaks of the Tobacco Beetle on some farms have been traced to the practice of keeping even a small stock of tobacco after the cessation of the tobacco sales.

This insect has been found breeding in fire cured tobacco, which is believed normally to resist insect attack owing to the deposits made on the leaf during the curing process. Samples of the infested tobacco examined were, however, not typical of fire cured leaf and are believed to have been insufficiently exposed to the curing process.

(*b*) *Maize.*—The subnormal infestation of maize grain by the Maize Weevil, *Calandra oryzae*, L., towards the end of last year was reflected in a subnormal field infestation this

year when a field survey was made during May. Cleanliness in farm stores, the use of tanks or silos for grain storage, and the proper and early disposal of shelling dumps are being urged.

Experiments in the modification of storage practice have not progressed satisfactorily during the year owing to the difficulty of obtaining the use of a suitably situated stack for a sufficiently lengthy period.

11. **Miscellaneous Insect Records.**—The following insects and their host plants are worthy of record. Some of the records are the result of observations made during the year, and others are records held over from previous years pending authentic identification of the insects concerned:—

(1) The beetle, *Exora kohlschutteri*, Wse. (Galerucidae) which defoliates the seeling leaves of sunn hemp (*Crotalaria juncea*).

(2) The weevil, *Apion asphaltinum*, Boh., which breeds in the seed pods of *Indigofera emarginella*, Steud.

(3) The beetle, *Zygaenodes capensis*, Jord., (Anthribidae) which emerges from the seed of *Burkea africana*, Hook., in July.

(4) The moth, *Aphomia pimelodes*, Meyr., (Pyralidae) whose caterpillars infest the seed pods of *Cassia abbreviata*, Oliv., and mature during May.

(5) The grasshoppers, *Catantops melanostictus*, Sch., (Acridiidae) which injures the leaves of tobacco in December.

(6) The beetle, *Bruchus albosparsus*, Fhs., which is found in the seed pods of *Acacia* sp. in December.

(7) The beetle, *Bruchus obscurus*, Fhs., which breeds in the seeds of *Indigofera arrecta*, Hochst.

12. **The Insect Collection.**—The following numbers of identifications of insects were made during the year by the institutions named:—

The Imperial Institute of Entomology, London: 128;

The British Museum (Nat. Hist.), London: 14:

The University Museum, Oxford: 23;

Zoologische Sammlung, Munich: 22;

The American Museum of Natural History, New York: 30;

The South African Museum, Cape Town: 16;

The South African Institute for Medical Research, Johannesburg, 7;

The Department of Agriculture and Forestry, Pretoria: 5;

The National Museum of Southern Rhodesia, Bulawayo: 35.

More than two hundred species of insects were sent for identification to specialists in Africa and overseas during the year.

A large number of insects, including the types or paratypes of some species new to science, were presented to the British Museum (Nat. Hist.); Muséum d'Histoire Naturelle, Paris; the Egyptian Universtiy, Cairo; the American Museum of Natural History; the National Musuem, Bulawayo; and to several scientific workers in Europe and America. During the year a large collection of ants (Formicidae) and spider-hunting wasps (Pompilidae) were donated by the Director of the National Museum of Southern Rhodesia. Capt. R. H. R. Stevenson kindly presented a collection of Chrysomelid beetles.

Progress has been made in transferring and arranging part of the collection in cabinets. This work has been going on for some years, and it is hoped that all the collection will be suitably preserved in the near future.

MEDICAL AND VETERINARY.

Tsetse Fly Operations.—In my report for 1937 the immediate objectives of the present policy as laid down by Government were outlined and some progress along these lines has been made during the year. The objectives were as follows:—

(*a*) In the northern districts to drive the fly below the escarpment and to reclaim the Urungwe Native Reserve.

(b) In the Hartley, Sebungwe and south-western portion of the Lomagundi district to drive the fly back to a line running roughly from the south-western beacon of the Urungwe Native Reserve to a point north of Gokwe.

(c) In the Wankie, Bubi and Sebungwe districts, to drive the fly some twenty miles north of the Shangani River. Eventually these operations will be extended slowly in this area to a line running from Tshete on the Zambesi River to the south-western beacon of the Urungwe Native Reserve, that is, to about latitude 17° 15′ north.

During the year a decision was made to extend the operations below the escarpment in the Darwin district into the Zambesi Valley in an attempt to clear the district of tsetse. This attempt can only be partially successful as tsetse, *Glossina morsitans,* is present in Portuguese East Africa on the M'kumvura River and, therefore, the northern portion of the district will always be subject to incursions of fly. Nevertheless, it may be possible to eradicate tsetse from the Mzarabani Native Reserve. The Chiswiti Reserve is now considered free from fly.

The extension of the operations has necessitated moving forward two main camps, redistributing the native hunters and the construction of new roads or the opening up of old roads. Little ground has been recovered from tsetse during the year, as it will take some two or three years before the results of these thrusts forward become manifest. On the other hand, no ground has been lost, and the ground recovered in previous years has been consolidated and further protected as we have advanced.

The reserve supply of Martini ammunition became dangerously low during the year and, in consequence, the number of native hunters had to be reduced considerably. New supplies have now been received and it has been possible to intensify the operations where necessary.

The presence of unbridged and at times unfordable rivers is now making the control of the operations in these advanced areas very difficult during the rains, and as the front line is pushed forward, these conditions make the cost of getting supplies to the base camps correspondingly greater. Road

construction and maintenance now constitute a heavy item of expense, which will tend to increase in the future. Roads are essential, however, in the opening up of the country and in facilitating prospecting in areas which are at present little known and remote from civilisation.

Animal trypanosomiasis is now rarely encountered as a result of the tsetse fly being driven back from settled European areas and because of the greater control which is being exercised over the distribution of native-owned cattle. Apart from the fairly heavy losses on the Eastern Border, where about 60 cases occurred, only five cases were recorded, all from the Urungwe sub-district. In the Doma area there are now some 1,800 head of native cattle running in country formerly infested with tsetse, and up to the present no cases of trypanosomiasis have been recorded. No cases of human trypanosomiasis occurred during the year.

Continued reports are being received of the increase of game behind the line of hunters. In this connection it is not generally realised that the destruction of elephant, rhinoceros, hippopotamus and giraffe by our European and native hunters is prohibited in the area covered by these game elimination operations, and it is a pleasure to record that the native hunters observe the law strictly, probably much more so than would Europeans in the same circumstances. In the Darwin district several of the hunters have been treed for long periods by infuriated rhinoceros, but none has been shot either in self-defence or for any other reason. In the Gatooma district one elephant was shot in self-defence after a pair of cows made repeated attempts to trample the frail hut in which two hunters were sleeping. This self-restraint is most commendable. Convictions were obtained against two Europeans for the illegal shooting of two rhinoceros.

During the last few years the small uninfested area on the Zambesi River opposite Feira became infested with fly and the few remaining native cattle have died. This spread is a continuation of the movement which has been going on ever since the rinderpest epizootic in 1896 when the fly belts in Southern Rhodesia contracted to very small and isolated areas. It has no connection with shooting operations carried out by Government, as there are no hunting natives below the

escarpment in this area. At this point the fly has spread into Portuguese East Africa and the Portuguese authorities have suggested, in a recent publication, that the invasion is due to our operations against game. We are convinced, however, that this spread is unconnected with our operations.

The position on the Eastern Border in the Melsetter district still causes anxiety, and an aerial survey of that portion of the border threatened with invasion by *G. morsitans* was commenced during the year. The photography has not yet been completed. *Glossina pallidipes* and possibly *G. brevipalpis*, both of which have been found on the Rhodesian side of the border during the year, have caused fairly severe losses of stock on a few farms close to the border, and two cases occurred some distance from the border.

The traffic cleansing chamber on Walker's Road, in the Wankie district, was closed down during the year, being no longer necessary.

A portion of the game fences in the Gatooma district were sold during the year, but as the cost of taking down the wire and transporting it to a central camp was greater than the money obtained at the sale, a distinct problem has arisen as to the best method of ultimately disposing of the game fences in the Hartley and Lomagundi districts, which are now no longer required.

SHORT SURVEY OF THE OPERATIONS BY DISTRICTS.

1. **Darwin.**—The position in this area is considered to be very satisfactory. An increasing number of cattle is being placed in the Kandeya Native Reserve, and up to the present no cases of trypanosomiasis have been reported. The operations were extended below the escarpment in June, and already there is evidence that the heavy concentration of tsetse at the foot of the escarpment is breaking up and the game is migrating further afield across the Umsengedsi River. As far as can be ascertained, the Chiswiti Native Reserve is now free from fly. The presence of rhinoceros and elephant is troublesome, and may delay the attainment of our objective, but

none of these animals has been shot. Owing to the fact that much of this area is very sparsely populated, some difficulty has been experienced in posting the native hunters, but the position in this respect is improving.

2. **Sipolilo.**—No cases of trypanosomiasis have occurred and no tsetse have been seen south of the escarpment during the year. Some derelict farms have been reoccupied along the Hunyani River where, in former years, heavy losses of stock have occurred. The general position is satisfactory.

3. **Lomagundi (Doma).**—There are now about 1,800 head of cattle between the game fences, and there have been no cases of trypanosomiasis since the natives were permitted to take their cattle back into the area. A native whose rifle had been taken away brought in two tsetse stated to have been caught between the fences, but repeated search failed to reveal any more. It is suspected the native was trying to get his rifle back, an action readily understood, as the possession of a rifle is a definite monetary asset, and gives social prestige. With the exception of these two flies, none has been seen south of the escarpment during the year. A few natives living north of the northern fence on the Rakutu River are so satisfied that no fly exists south of the escarpment that they have asked to be allowed to take their cattle into the area. It should be mentioned that this area is one of the old residual "foci" of fly which persisted after the rinderpest epizootic in 1896, and it is improbable that cattle ever lived in the area in the past.

4. **Urungwe.**—Tsetse has again descreased in the northern portion of the area, this improvement being reflected in the decrease in fly caught at Vuti cleansing chamber and the total absence of fly at Manyangau chamber since March. On the western side of the area an occasional long-ranging fly has been caught several miles from the edge of the known permanent fly belt. A few cases of trypanosomiasis have been diagnosed by blood films (five), but in general the position has slightly improved, and is regarded as quite satisfactory.

Motor traffic on the main north road to Chirundu has been heavy, but game is scarce, and practically no fly exists in the vicinity of the road. Remote from the road fly is fairly

dense, particularly around pans containing permanent or semi-permanent water, and immediately below the escarpment where water always occurs.

5. **Lomagundi, S.W.**—With the exception of two fly caught in January near the Susuje River, no tsetse has been taken north of the Umfuli River, or on the east bank of the Sanyati River above the junction of the Piriwiri River during the year. On the west bank of the Umniati there appears to be no fly between the Copper King Mine and the Mongololo River. Occasional fly are seen near the Emerald Mine, and fairly dense fly are encountered further up stream above the Emerald drift.

The main camp has been moved thirty miles west to the Copper Queen drift on the Sanyati River, and the area of operations extended to the west bank of the river.

The area lying east of the Umfuli and Sanyati Rivers in this section may now be considered free from fly.

6. **Gatooma.**—Tsetse still persist close to the Umniati River on the eastern bank from a point five miles north of the Rhino Mine to a little below the Nyhondi River, but it has been reduced in density during the year. On the Nyhondi a small local focus of fairly dense fly still exists in the presence of a herd of elephant. West of the Umniati there are some dense patches of fly near the Ongwe River, but these now are breaking up. The main camp has been moved fifty miles further west to the Umniati River about five miles down stream from Gowe. With the exception of two flies caught near Kamongo Hill outside the fenced area, the old shooting area has remained free from fly. A small herd of cattle which was taken to Gambeza during the year has remained in good condition, with the result that more natives have asked permission to take cattle into the fenced area. Shortage of surface water will prevent the development of the area now cleared of tsetse and otherwise suitable for native settlement. Little maintenance work has been carried out on the game fences, which are now left well behind the area of operations.

7. **Gwaai-Shangani Area.**—The area between the Gwaai and Shangani Rivers has remained free of tsetse during the year. All shooting by native hunters has been stopped south

of the Shangani River and the line of operations pushed forward north of the Mkulu-Gusu Forest belt, as far as Pashu Native Reserve. The main line of hunters is now established on the Mzola River.

No fly has been taken on the Kana River and only an occasional fly on the Mzola River, from which source an occasional fly—three in all—has been caught near the new Changwe coal mine on the Bira River close to Lubimbe Vlei. One stray tsetse was taken on the headwaters of the Tshongokwe River some thirty miles from its junction with the Shangani River. No fly has been caught on the Shangani River during the year.

Walker's Road to the Zambesi River appears to be free from tsetse, and, in consequence, the cleansing chamber was closed down in May. The fly-belt for long associated with the Gwaai and Shangani Rivers has now disappeared and game is being allowed to increase unmolested between these two rivers.

No cases of animal trypanosomiasis have occurred on the Gwaai River Settlement farms, or on the native settlement in the Mabare Valley during the year.*

The main camp is now well behind the line of operations and will have to be moved forward next year. Unfortunately, during long periods when the Shangani River is in flood, it is impossible to get through supplies, or to communicate by means of native runners. With the co-operation of the Native Commissioner, Gokwe, a portion of the old road from Bulawayo to Kariyangwe was re-opened, as it is expected that the next main camp will be built near Kariyangwe.

8. **Melsetter Border.**—Although the border clearing was widened during the previous year, a number of cases of animal trypanosomiasis occurred on a few farms in the vicinity of Mount Selinda. These farms are all connected with the Inyamadzi and Cheredza Rivers and their tributaries. The dominant forest types are *Brachystegia* and *Uapaca*, though thicket occurs close to the rivers. A special effort was made

*About twenty cases involving thirteen deaths have since been reported from the Mabare Valley.

to discover tsetse on the Rhodesian side of the border, resulting in the discovery of eleven flies, comprising seven *G. pallidipes* and four *G. brevipalpis*. A Harris fly trap was used to attract the flies, but the majority were caught off man. It is not known whether these species are permanently resident and breeding in the Colony, but from the distribution of the catches it is becoming clear that the Inyamadzi River Valley forms the main route along which the flies enter the Colony at this part of the border.

With the consent of the Portuguese authorities a visit of inspection was made in Portuguese East Africa, and the presence of *G. morsitans* in some numbers about six miles from the border was confirmed and occasional flies found much closer to the border. In connection with this threatened invasion of *G. morsitans*, an aerial survey of a portion of the southern Melsetter border was authorised and was carried out by the Rhodesian Air Unit, the ground control being done by this Branch. From the photographs a large-scale topographical map will be prepared and used as a base for an ecological map which will be prepared by the Conservator of Forests to show the distribution of forest types along the border. The final map will probably not be completed before the next dry season. For permission to fly over Portuguese territory grateful acknowledgement is made to the Portuguese authorities at Beira.

As in previous years, the border clearing was maintained by the slashing back of all re-growth, and a very good burn burn was obtained at the end of September. The clearing was widened on the farms "Bayswater," "Pendragon," "Grampians" and "Farfell," particular attention being paid to the Inyamadzi River Valley.

Traffic Control.—As previously mentioned, the traffic cleansing chamber on Walker's Road was closed down in April, reconnaissance surveys having shown that the road is practically free of tsetse between the Shangani River and the Zambesi. The road is in very bad condition and, consequently, has not been used beyond the Shangani River for many years, except by pedestrians. A certain amount of traffic developed to a coal mine which was opened up on the

Bira River north of the Shangani. Three flies were caught in the vicinity of the mine during the year, but as the chamber is at least 14 miles from the mine, it was not considered necessary to re-open the chamber.

In the Urungwe district there was a considerable increase in the number of motor cars, and a slight decrease in pedestrian traffic using the road to Chirundu (Otto Beit Bridge). A slight decrease in the total number of flies taken off traffic was recorded. No flies have been taken at Manyangau chamber since April, and this chamber will be closed down early in the coming year if the satisfactory position is maintained. The improvement on the main road is entirely due to motor traffic, and to the presence of large road gangs which have driven game away from the road. The improvement at Manyangau is due to the extention of the operations to protect the new mica fields north of the Mkwichi River.

In the Darwin district there is practically no change on the Nyamarapara Path, and none was expected, as the operations were not extended below the escarpment until June. No flies have been caught at the Kapanda Path leading into the Chiswiti Native Reserve, and this chamber will be moved further west early in the coming year to deal with traffic from the Mzarabani Reserve.

The details of traffic dealt with are as follows:—

1. **Miami-Zambesi Road.**—(*a*) *Vuti Chamber.*—964 motor cars bringing 75 flies (37 male, 38 female), 3,365 pedestrians and 225 cyclists in 1,042 parties bringing 87 flies (51 male, 36 female). Total 162 flies (88 male, 74 female).

Compared with 1932 (106); 1933 (94); 1934 (178); 1935 (454); 1936 (519); 1937 (241).

(*b*) *Manyangau Chamber.*—3,823 pedestrians and 262 cyclists in 1,032 parties bringing 6 flies (3 male, 3 female).

Compared with 1935 (296); 1936 (401); 1937 (88).

2. **Walker's Road.**—7 motor cars and 277 pedestrians in 132 parties bringing no flies.

This chamber was closed down in May, the last fly being caught off a car in May, 1935, and off a pedestrian in December, 1935.

3. **Darwin.**—(*a*) *Nyamarapara Path.*—2,011 pedestrians and 84 cyclists in 528 parties bringing 38 flies (26 male, 12 female).

Compared with 1932 (112); 1933 (97); 1934 (85); 1935 (161); 1936 (403); 1937 (40).

(*b*) *Kapanda Path.*—2,415 pedestrians and 125 cyclists in 744 parties bringing no flies.

Compared with 1936 (six months 15); 1937 (3).

Tsetse Fly Research.—Laboratory research on the physiology and behaviour of *G. morsitans*, which was commenced in 1935, was suspended in July, and a field research station opened at Chipatani in the Urungwe sub-district. The station was equipped with several sets of meteorological instruments for the standard Stephenson screen and also with a number of self-recording thermohydrographs. Daily meteorological records were taken at selected sites in different types of bush and at various altitudes, the lowest being on the Zambesi River at the western end of the Kariba Gorge at approximately 1,500 feet. Some interesting observations have been recorded on a number of problems, *e.g.*, fluctuating fly densities, seasonal distribution and nourishment of the fly, attraction to man and a moving vehicle, the presence of game, and the association of game with fly. This station was closed down in December.

The number of tsetse fly puparia collected at Chipatani during the year was 10,488 (January to June), and 2,880 flies were bred out at Salisbury for experimental work.

The results obtained from the laboratory work are being published in a paper which is in the press. The field investigations will be dealt with in a later report.

Trypanosomiasis Committee.—All meetings of the Trypanosomiasis Committee were attended, the chief matters under discussion being (1) the threatened invasion of the Melsetter district by *G. morsitans*, and (2) the question of the adoption of a long-range policy for the ultimate eradication of tsetse from the main *morsitans* belt in the north.

The late Mr. C. F. M. Swynnerton, C.M.G., attended one of the meetings and outlined the work in progress in Tanganyika.

I should like to place on record here the deep loss that science, particularly those workers on the tsetse fly problem, has suffered by the tragic death of one who was an outstanding authority, not only on tsetse but on many other matters relating to the flora and fauna of Africa.

During the year the Secretary of the Committee, Mr. L. E. W. Bevan, M.R.C.V.S., retired, and now the Committee appears to be in imminent danger of dying from inanition. The library of reprints formed by Mr. Bevan for the Trypanosomiasis Bureau is not available for consultation.

Flies of Medical and Veterinary Interest.—The Screwworm Fly (*Chrysomyia bezziana*, Vill.) continues to be a serious pest of cattle in many localities. Several cases of myiasis in man due to skin-maggots (*Cordylobia anthropophaga*, Blanch.) were reported during the wet season. A species of midge, *Simulium lepidum*, De M., was found breeding in large numbers in streams on the Vumba Mountains, near Umtali, in March. The study of the biology of some common flies which breed in cattle dung, stools and decomposing animal matter has been continued.

Tick Survey. — The Spinose Ear-tick (*Ornithodorus mégnini*, Dugès) was found in the Salisbury district in May infesting the ears of cattle and sheep. The ticks, *Amblyomma marmoreum*, Koch. and *A. nuttalli*, Dönitz, were found on tortoises in the Makoni and Bulalima-Mangwe districts during August and September.

Bed Bugs (*Cimex lectularius*, L.).—Experiments in the control of bed bugs in native quarters have been continued. The control consists of restricting the bugs to the lower parts of the rooms by means of barriers and shelters, and in killing them regularly by means of a blow lamp at the barrier.

ADMINISTRATION.

Tobacco Pest Suppression Act, 1933.—Under Part I. of the Act, which applies to stored tobacco, the Tobacco Beetle *Lasioderma serricorne*, F., was found in two central ware-

houses and four farm warehouses. The Stored Tobacco Worm, *Ephestia elutella*, Hubn., was suspected to be present in one central and one farm warehouse. All cases of infestation by stored tobacco pests were traced to the objectional, but occasionally necessary, practice of retaining tobacco in the premises or to the failure to destroy waste tobacco. This practice is, unfortunately, becoming more common, and will constitute a serious menace unless the growers adopt the storage methods advised by the Department.

Under Part II. of the Act, applying to growing tobacco, the Tobacco Whitefly, *Bemisia rhodesiaensis*, Corb., was found together with leaf curl on eight farms. The disease infested plants were destroyed by the owners. Tobacco re-growths were very numerous on sixteen farms. Five farms were re-inspected by members of the British South Africa Police to confirm that destruction of field refuse had been carried out. It is proposed to enter into closer co-operation with the Police in order that greater attention can be given to the question of re-growth during future spring months, as it is impracticable for the inspector to visit all growers during these periods.

The Tobacco Aphis, *Myzus (Aphis) persicae*, Sulz., was prevalent in the Lomagundi district. Localised outbreaks were also serious elsewhere, particularly in the Makoni and Umtali districts. This insect has been found to be the vector of the newly discovered virus disease, Tobacco Rosette, which constitutes a serious threat to the tobacco growing industry. The Tobacco Research Board had notified its intention of carrying out investigations at Trelawney in connection with Tobacco Aphis. After discussion with the Rhodesia Tobacco Association it was decided to include Tobacco Rosette as a pest under the Act. The disease has now been included and the Department given the authority to apply any reasonable control measures which may be found necessary.

Number of Licences Issued and Inspections Made.

	1938.	1937.
Licences	655	583
Inspections	566	350

The figures for inspections do not include those made by the Police. The whole-time Inspector was on sick leave for a month, but twelve months' working at the average rate performed during the eleven months of inspection would not have resulted in the inspection of all premises.

Importation of Plants Regulations Ordinance, 1904.—Regulations were published during the year under the Ordinance authorising the rejection of all consignments of fruit showing more than 5% infestation with Codling Moth, *Cydia pomonella*, L., and the charging of a fee of 3d. per tray or 1s. per bushel on all consignments showing less than 5% infestation. It is hoped by these measures to prevent the introduction of this dangerous pest, which is not known to occur in Southern Rhodesia. It is believed that an additional benefit will be an improvement in the quality of fruit imported.

The precautionary measures to prevent the entry of Citrus Canker from the Union of South Africa were withdrawn.

Plant Regulatory Board.—Four meetings of the Plant Regulatory Board were held during the year, the subjects dealt with included the following:—

(*a*) Importation of pest-infested and inferior quality fruit from the Union;

(*b*) Citrus Canker regulations;

(*c*) Exportation of citrus fruit to Ceylon, with reference to fruit fly infestation;

(*d*) Certification of imported seed potatoes;

(*e*) Distribution of Root Gallworm in the Colony; and

(*f*) Illegal sale of nursery stock.

Intercepted Pests.—Red Scale (*Aonidiella aurantii*, Mask.) was found on orange fruits imported from Cape Province. Mussel Scale (*Lepidosaphes beckii*, Newm.) and False Purple Scale (*Chrysomphalus pinnulifera*, var. *diversicolor*, Green) was found on grape fruit imported from Portuguese East Africa. A species of scale insect of the genus *Saissetia* was

found on mango fruit imported from Portguese East Africa. Some consignments of potatoes imported from the Union were infested with Tuber Moth (*Phthorimaea operculella*, Zell.) and eelworm (*Heterodera marioni*, Goodey).

Number of Consignments of Plants, Fruit, etc., dealt with at Ports of Entry.

	1938.	1937.
Salisbury	3,638	2,834
Bulawayo	12,821	11,221
Umtali	1,677	1,153
Gwelo	1,270	1,027
Plumtree	276	351
Beitbridge	—	—
	19,682	16,586

Number of Permits for the Introduction of Plants into the Colony.

	1938.	1937.
Special Permits	272	252
Annual Permits	60	62

The increase in the number of Special Permits was due to the practice of issuing permits, on request, for the introduction of bulbs. Such permits are not required by regulation, but in the past delay has occurred in the exporting country owing to the assumption that permits were necessary.

Regulations in other Countries affecting Export of Plants from Southern Rhodesia.

Number of Certificates of Cleanliness issued in respect of Plants, etc., for Export.

	1938.	1937.
Certificates	56	48

More certificates were issued in respect of potatoes destined for neighbouring countries than for any other class of plant.

Injurious Substances and Animals Ordinance, 1909.

Number of Permits Issued for the Importation of Bees, Beeswax and Foundation Comb from Overseas.

	1938.	1937.
Bees	—	—
Foundation Comb	—	—
Beeswax	1	3

The above permits are in respect of importations from overseas only. Importations from the Union of South Africa are unrestricted, and no records of such are kept by the Department.

Nurseries Ordinance, 1909: as Amended.

Number of Nurseries Registered and Inspected.

	1938.	1937.
Registered	16	13
Inspections	11	10

One nursery in the Salisbury district was placed in quarantine on account of Red Scale on citrus trees, and Woolly Aphis on apple trees.

GENERAL.

Farms Visited.—Forty farms were visited and advice given on pest control in addition to five hundred and sixty-six inspections made under the Tobacco Pest Suppression Act, 1933.

Lectures and Demonstrations.—A comprehensive exhibit containing some new features designed to promote the interest of visitors was placed on the Agricultural Show at Salisbury, and a talk on insects was given to scholars.

Four lectures on ticks were given to members of the British South Africa Police. One lecture on insects was given to a school science club, and a talk on *Cleanliness Aids Insect Control* was broadcast to farmers and others.

PUBLICATIONS.

The following papers by members of the staff were published during 1938:—

1. "Army Worm," Anon., *Rhod. Agric. Journ.*, XXXV., 2, pp. 123-125. Salisbury, February.

2. "How to make Tobacco-Wash on the Farm," by M. C. Mossop, *Ibid.*, XXXV., 2, pp. 130-133 (Bull. 1060). Salisbury, February.

3. "Poison Bait for Young Locust Hoppers," Anon., *Ibid.*, XXXV., 2, pp. 134-138 (Bull. 1059). Salisbury, February.

4. "On the Immature Stages of *Psilocephala africana*, Wied. (Therevidae), together with a description of a species of *Microstylum* Macq. (Asilidae) new to Science," by E. O. Engel and Alexander Cuthbertson, *Trans. Rhod. Sci. Assoc.*, XXXV., Pt. 2, pp. 132-135 (Illustrated).

5. "The Maize Weevil Problem" (Correspondence), by M.C. Mossop, *Rhod. Agric. Journ.*, XXXV., 4, pp. 253-255. Salisbury, April.

6. "Notes on Maize Weevil (*Calandra oryzae*, L.)," by M. C. Mossop, *Ibid.*, XXXV., 6, pp. 415-416. Salisbury, June.

7. "The late Mr. C. F. M. Swynnerton, C.M.G.," by R.W.J., *Ibid.*, XXXV., 8, pp. 611-616. Salisbury, August.

8. "Annual Report of the Division of Entomology for the Year ended 31st December, 1937," by R. W. Jack, *Ibid.*, XXXV., 8, pp. 652-676 (Bull. 1080). Salisbury, August.

9. "Why Cleanliness Aids Insect Control," by M. C. Mossop, *The Rhodesia Herald*. Salisbury, 17th August, p. 32 (Illustrated).

10. "The Life History of Root Gallworm or Root Knot Eelworm," by M. C. Mossop, *Rhod. Agric. Journ.*, XXXV., 9, pp. 720-722 (Bull. 1082). Salisbury, September (Illustrated).

11. "The Spraying of Tobacco Seed-beds and Control of Rosette Disease," by J. C. F. Hopkins and M. C. Mossop, *Ibid.*, XXXV., 10, 760-764 (Bull. 1086). Salisbury, October (Illustrated).

12. "An Experimental Pack for Virginia Tobacco," by M. C. Mossop, *Ibid.*, XXXV., 10, pp. 796-799. Salisbury, October.

13. "On the Biology of *Craticulina tabaniformis*, F. (Sarcophagidae) which breeds in the nests of Sand Wasps (Bembex)," by Alexander Cuthbertson, *J.S.Afric. Ent. Soc.*, 1, pp. 1-8. Pretoria (Illustrated). (In the Press).

14. "A Short Historical Account of Tsetse in Southern Rhodesia," by J. K. Chorley, *Proc. Rhod. Sci. Assoc.*, XXXVI. Salisbury, December.

15. "The Breeding Habits and Economic Significance of some Muscoidean Flies in Southern Rhodesia," by Alexander Cuthbertson, *Ibid.*, XXXVI. Salisbury, December.

16. "Biological Notes on some Diptera in Southern Rhodesia," by Alexander Cuthbertson, *Trans. Rhod. Sci. Assoc.*, XXXVI. Salisbury, December (Illustrated).

17. Monthly Reports on the Locust Position, by R. W. Jack, *Rhod. Agric. Journ.*, XXXV., Nos. 1-12. Salisbury, January-December.

18. "Studies in the Physiology and Behaviour of *Glossina morsitans*, Westw., by R. W. Jack, *Mem. Dept. Agric. S. Rhodesia*, No. 1. Salisbury, December (in the Press).

19. Miscellaneous official articles for the Press, Anon.

Staff.—I regret to record the death from heart trouble in July of Mr. J. W. J. Struthers, who joined the staff as a Tsetse Fly Ranger in May, 1927, and who, for eleven years, gave of his best in the difficult and lonely task of controlling tsetse fly under the very arduous and primitive conditions attached to the work. He shirked no job.

Two Rangers resigned during the year, and one has been replaced.

Acknowledgements.—I have pleasure in acknowledging the ready assistance and co-operation given by members of other Departments and by other Divisions of the Agricultural

Department during the year. In particular I wish to mention the officers of the Native Affairs Department and members of the B.S.A. Police, who bear the brunt of locust work in the field, the members of the Air Unit of Southern Rhodesia for their work in connection with the aerial survey of the Eastern Border, the officers of the Divisions of Forestry and Plant Pathology for numerous identifications of plants, and the officers of the Division of Chemistry for work in connection with Tsetse Fly Research.

I wish to thank all members of the staff, who have readily and conscientiously carried out their duties during the year.

Cleanliness Aids Insect Control.

Rhodesian Milk Records.

OFFICIAL RECORDS.

Name of cow	Breed	Milk in lbs	B. Fat in lbs	Av % B.Fat	No.of days	Name and address of owner
Matopo Drinkstone Missie III . 23rd. August, 1931	Red Poll	5,695.00	217.05	3.81	300	The Government Experimental Farm, Rhodes Matapo Estate P/B 19k, Bulawayo
Matopo Brightwell Rain I. .. .. 4th January, 1931	do.	13,253.40	512 09	3 89	300	do. do.

SEMI-OFFICIAL RECORDS.

Name of cow	Breed	Milk in lbs.	B. Fat in lbs.	Av. % B.Fat	No.of days	Name and address of owner
Pig	G. Friesland	5,025 30	185.93	3.70	300	Mrs. E. A. Barbour,
Rhoda ..	do	5,258 50	184.46	3.51	300	Fairview, Sinoia
Dawn . .	do.	5,313 10	196.25	3 69	257	T Cousins, Oak-lands, Gwelo
Gutu	do.	5,116.70	181.18	3 54	300	P. Freeland, Ling-
Longone .. .	do.	5,080 00	183.43	3.61	300	field, Gwelo
Vetkop	do.	4,671.20	184 79	3 96	300	do. do.
Connie II	do.	8,241.00	280.42	3.40	300	W. D. Haywood,
Cynite	do.	6,811 00	247.61	3.64	300	Ordoff Farm,
Decia .	do	6,510 00	212 97	3.27	300	Gatooma
Minnie ..	do.	7,159.00	218.36	3 05	263	do do.
Nora II ..	do.	7,637.00	336 24	4 40	290	do do.
Sue .	do.	6,631.00	256 67	3.88	300	do. do.
Jenny . .	do.	7,610 40	231.84	3.04	300	Mrs. M. L. Higgin-
Gwebi Antbloem .	do.	7,048.50	228.55	3 24	300	son, "Wendiri,"
Joyce ..	do.	6,073 20	208 72	3 44	300	Msonneddi
Monica	do.	6,194.10	198.05	3.20	300	do. do.
Pat ..	do.	7,581.40	259 30	3 42	300	do. do.
Phyllis	do.	6,825.50	232.05	3.40	300	do. do.
Amy	do	6,384.00	192.74	3.02	300	V. A. Lawrence,
Blossom	do.	6,686 50	230.32	3.44	300	Knockmaroon
Ellaglen	do.	6,228.50	182 05	2 92	291	Farm, Norton
Erica	do.	6,182.50	233.25	3.77	300	do do.
No. 12 . .	do.	6,721.00	228.60	3.40	300	Mazoe Citrus Estate, P O., Mazoe
No 145	P. B. Fries.	7,339 00	230 05	3 11	300	Messrs. Meikles
No. 219 .	do.	9,253 00	298 55	3 23	300	Bros , Leachdale,
No. 261	do.	9,936.00	307.33	3.09	298	Shangani
No. 23 ..	G. Friesland	6,392 00	202 52	3.17	300	do. do.
No. 103 .. .	do.	6,3[illegible]7 00	211 94	3 36	300	do. do.
No. 256 .	P. B. Fries.	8,579 00	282.07	3.29	300	do. do.
Annetta I . .	do.	12,386.50	398 03	3 21	300	W. S. Mitchell,
Annetta II A. ..	do.	5,915 00	231.62	3 91	300	Springs Farm,
Annetta III A. . .	do	6,038 00	198 89	3.29	300	Iron Mine Hill
Annetta V. .	do.	8,574 00	266 64	3 11	300	do. do.
Sheep Run Dainty...	do.	11,521.50	394 16	3.42	300	do. do.
Sheep Run Destiny	do.	12,637.50	442 11	3 50	300	do do.
Sheep Run Dorina...	do.	7,051.50	280.76	3.98	300	do. do.
Sheep Run Lady ...	do.	11,854 50	392 89	3.31	300	do. do.
Sheep Run Prudence	do.	9,359.50	353.79	3 78	300	do. do.
Anneeed	do.	8,047.50	257.84	3.25	300	do. do.
Annetta I A ...	do.	9,155 00	268.83	3.13	300	do. do.
June	G. Friesland	5,156.50	190.22	3.70	300	Commander E. L. Morant.R N (Ret.), Marangwe, S'by.

Name of cow	Breed	Milk in lbs.	B. Fat in lbs.	Av. % B.Fat	No.of days	Name and address of owner
No. 9	do.	6,058.00	186.55	3.08	270	F. B. Morrisby, Sun-
No. 14	do.	6,183.00	183.45	2.97	264	nyside, Gwelo
Broom II	do.	5,571.40	188 06	3.38	279	W. F. H. Scott,
Adami	do.	7,581.80	227.47	3.00	300	Maple Leaf,
MgodeIII	do.	8,776.00	295.09	3.36	256	Norton
Whinburn Tulip ...	do.	5,966.20	210.67	3.53	262	Major R R. Sharp, Whinburn, Red-bank.
Cherie	do.	6,437.70	237.26	3.69	300	W. Sole, Bauhinia,
Cassie	do.	5,435.80	193.34	3.56	300	Glendale
No. 95	do.	5,953.80	211.67	3.56	300	A. Stokes, Safago, Gwelo
Betsy	do.	5,405.50	213.82	3.96	265	W. E. Tongue, North Lynn, Bulawayo
Bawdsey Pear ...	P.B. Red Poll	6,088.00	227.89	3.74	300	Messrs. Tredgold
L.4	G. Red Poll	4,504.00	224.49	4.98	300	Bros , Cressydale,
9.T.B.	do.	6,344.50	282.85	4.46	300	P.O. Lydiate

Name of cow	Breed	Milk in lbs.	B. Fat in lbs.	Av. % B.Fat	No.of days	Name and address of owner
Chipaka	G. Friesland	5,122.90	199.66	3 90	300	J. R. Bedford,
Porky	G. Guernsey	5,286.20	198.81	3.76	300	Poltimore Estates, Marandellas
No. J31	G. Friesland	7,076.70	238.26	3 37	262	A. L. Bickle, P.O Box 466, Bulawayo
Signora	do.	6,927.10	242 93	3 51	300	Boyd Clark Estate,
Truant	do.	5,252.00	180.51	3 44	300	Castle Zonga,
Daisy	do.	5,546.30	207.65	3 74	300	Inyazura
No. 269	do.	5,857.50	237.46	4.05	300	Coldstream Dairy,
No. 246	do.	4,569 00	182.88	4.00	300	Headlands
No. 242	do.	7,461.00	217.33	2 91	300	do. do.
No. 172	do.	5,858.50	217 05	3.71	282	do. do.
No. 220	do.	5,692.00	184.23	3.24	300	do. do.
No. 59	do.	6,631.50	211.06	3.18	300	do. do.
Gower Hill Audrey	do.	8,038.70	328 75	4.09	280	Gower Hill Dairy,
Gower Hill Monica	do.	6,240.40	283.63	4.55	300	P.O Box 1143,
Leyton	do.	5,450.20	207.29	3.80	300	Salisbury
Gower Hill Rhoda .	do.	6,120.70	239.58	3.91	300	do. do.
Jessie	do.	6,433.80	238.13	3.70	300	do. do.
Kathleen	do.	6,092.10	218.29	3.58	300	do. do.
Kitang	do.	5,112.40	188 54	3 69	300	do. do.
Ruby	G. Ayrshire	6,467.00	283.88	4.39	300	do. do.
Shamva .. .	G Shorthorn	5,516.00	224.44	4.07	300	do. do.
Viola	G. Friesland	4,802.10	197.13	4.15	300	do. do.
Xmas	do.	6,195.00	204.78	3 31	270	do. do.
Gower Hill Clara ...	G. Shorthorn	4,927.70	192.72	3.91	249	do. do.
Zinnia	G. Friesland	5,955.90	251 62	4 22	286	do. do.
Betty	do	4,173.50	183.71	4.40	300	do. do.
Della	G. Devon	5,508.30	271.28	4.95	255	do. do.
Dolly	G Red Poll	6,010.80	298.57	4.97	283	do. do.
Gower Hill Pandora	G Friesland	5,152.70	202 50	3.93	300	do. do.
Duchess	G. Jersey	4,687.90	213.02	4.54	264	do. do.
Gower Hill Amaryllis	G. Friesland	8,925.10	322.83	3.62	300	do. do.
Gower Hill Audrey	do.	6,436.20	285.17	4.43	295	do. do.
Mayfair	G. Jersey	4,375.20	261.53	5.98	300	do. do.
Jane	G. Guernsey	4,497.40	207 31	4.61	298	do. do.
Daffodil	G. Red Poll	4,864.90	196.61	4.05	300	E. C. Harrington,
Frolic	G. Red Poll x Friesland	5,437.80	209.30	3.85	300	Harleigh, Rusape
Swarke	G. Friesland	7,610.60	299.22	3.92	300	Mrs. E. D. Knill,
Naomi	do.	6,391.00	196.86	3.08	300	P.O. Marandellas
Grandma	do.	5,210.90	201.87	3.87	300	A. B. Marshall,
Mapinga	do.	5,486.40	202.26	3.68	300	Mimosa, Maran-
Jane	do.	5,110.50	202.94	3.97	300	dellas
Mona	do.	6,786.80	236.69	3.40	300	do. do.
Office	do.	5,135.20	181.54	3.54	300	do. do.

Name of cow	Breed	Milk in lbs.	B. Fat in lbs.	Av. % B.Fat	No of days	Name and address of owner
Putney	G. Friesland	4,302.80	197 92	4 60	300	Red Valley Estate, Lushington, Marandellas
Prudence	do.	5,358.60	193 30	3 68	300	Red Valley Estate
Pewter (Bertha III)	do.	5,148.90	183.85	3 57	300	"P" Herd, Lushington, Marandellas
Chenzira	do.	5,870.20	234.78	4 00	287	Red Valley Estate,
Mary	do.	5,511 70	220 83	4 07	300	Lushington, Marandellas
No. 182	do.	6,271 50	236.47	3 77	300	A. Stokes, Safago, Gwelo
Bigess No. II.	do.	6,717 00	218.33	3 25	300	P. S. Timms,
Snowy	do.	5,679 00	197.20	3.47	300	Chitora, Rusape
Martin Pam	do.	5,403 00	184 58	3 42	300	Union & Rhodesia
Dirko Celia II.	do.	6,258.50	215 91	3 45	300	Mining & Finance
Martin Donna I	do.	7,062 50	204 73	2.90	262	Co. Ltd., P.O. Box
Martin Sheilagh	do.	5,395 00	180 61	3.35	300	80, Salisbury
No. 174 Marrow	G. Friesland	4,738.70	182 33	3 85	300	Mrs. E. A Barbour, Fairview, Sinoia
Twinkie	do	8,801 30	286.20	3 25	300	J. R. Bedford,
Star	G Shorthorn	5,354 40	201 49	3 76	300	Poltimore, P O. Mangwendi, Marandellas
Palm Tree Moonbeam	P B. Fries	6,454 30	223 51	3 46	300	Bluff Hill Dairy, P O Box 346,
Gip	G. Friesland	4,680 30	198.76	4 25	300	Salisbury
Catherine I	do.	6,025 30	214.28	3 56	300	Boyd-Clark Estate,
True Girl II.	do.	5,546.50	187.17	3.37	298	Castle Zonga, Inyazura
No 51	do.	5,352 00	193 43	3.61	300	Coldsteram Dairy,
No 73	do	7,303 00	280 04	3 83	300	Headlands
No 130	do.	4,732.00	184 69	3 90	300	do do.
No. 213	do	6,010 00	234 95	3.90	300	do do.
No. 224	do.	6,041.00	215.13	3.56	300	do. do.
No 287	do	6,686 50	244 72	3 66	300	do do.
No. 295	do.	7,398.50	263 11	3 56	300	do. do
Bramble	do.	5,412.10	201 55	3 72	266	T. Cousins, Oak-
Jade	do	8,173 50	271 51	3 32	266	lands, Gwelo
Kerry	do.	6,323 90	249.29	3 94	275	do. do.
Marie	G Ayrshire	5,549 30	277 90	5 01	271	do. do.
Marina	G Friesland	4,509 80	183 94	4 08	238	do do.
Rita	do	5,924 30	211 24	3 57	251	do do.
Rosebud	do	6,749 30	233 36	3 46	300	do. do
Sister	do	5,542 80	195 21	3 52	228	do do.
June	do.	7,660 00	301.71	3.94	300	W. D. Haywood,
Rebecca	do.	6,475.00	222 87	3 44	293	Ordoff Farm, Gatooma
Alice	do.	6,698.70	213 03	3 20	300	Mrs. M L Higgin-
Angela	do.	7,665.60	244 98	3.20	300	son, Wendiri,
Betsie	do	10,754 30	319.05	2 97	300	M'Sonneddi
Joy	do.	7,646 40	243 33	3 18	300	do do.
Mabel II.	do	5,899.30	193 18	3.28	300	do. do.
Philippa	do	10,065 70	391 30	3 89	300	do. do.
Myra II.	do	4,995 20	202 25	4 05	276	E. C. Holmes, Echo
Ngyue	do	4,521.50	213 65	4 73	275	Farm, 87, Livingstone Av., S'bury.
Boncella	do.	7,845 20	255 03	3 25	250	Mrs E D. Knill,
Gedzi	G Lincoln Red	5,562.70	258 34	4.64	300	P O. Marandellas do do.
Buttercup	G. Friesland	5,403 00	226.06	4.18	347	V. A. Lawrence, Knockmaroon, Norton
Chimsana	do.	6,000 80	197 49	3 29	300	A. B. Marshall,
Plasman	do.	7,033 90	235.62	3.35	300	Mimosa, Maran-
Masasa	do.	5,397.20	189.57	3.51	300	dellas
Gamble	G. Ayrshire	4,322.50	209.22	4.61	296	Mjr F. H. R. Maunsell, Forres, P.O. Bromley
No. 33	G. Friesland	7,324.00	244.99	3 07	300	Mazoe Citrus Estate, P O., Mazoe
Annetta II.	P. B. Fries.	9,471.00	320 87	3.39	300	W S. Mitchell,
Annetta III.	do.	10,616.50	358.77	3.38	300	Springs, Iron Mine Hill
Dobbie	G. Friesland	7,418.00	218.63	2 95	300	F. B. Morrisby,

Name of cow	Breed	Milk in lbs.	B. Fat in lbs.	Av. % B.Fat	No.of days	Name and address of owner
Hartie	G. Friesland	5,988.00	184.01	3.07	300	Sunnyside, Gwelo
Millicent of Tolosa	do.	6,129.00	210.58	3.44	300	do. do.
Prudette	P. B. Fries.	6,280.00	201.98	3.21	300	do. do.
Victoria	G. Friesland	6,156.00	181.11	2.94	300	do. do.
Nyama	do.	8,132.80	254.70	3.13	300	W. F. H. Scutt,
Robert	do.	7,742.70	294 10	3.80	258	Maple Leaf,
Stence	do.	6,313.70	216.99	3.44	300	Norton
Vittoria	do.	6,247.10	225.94	3.62	300	do. do.
Lomans	do.	6,755.90	259.13	3.84	300	do. do.
Aggie	do.	5,881.90	182.28	3.10	300	W. Sole, Bauhinia, Glendale
No. 89	do.	7,604.00	249.29	3.28	300	A. Stokes, Safago,
No. 94	do.	5,3'3.20	198.61	3.74	300	Gwelo
No. 105	do.	6,495.60	227 02	3.50	300	do. do.
No. 125	do.	4,874.30	204.92	4 20	300	do. do.
No. 153	do.	6,555 90	216.41	3.30	300	do. do.
No. 6 .. .	do.	6,213.90	197.69	3.18	300	do. do.
Black	do.	6,121.60	237.72	3.88	261	do. do.
Sir Nel's Buttercup of Shanks ...	Pedigree Guernsey	4,473.50	204.96	4.58	227	do. do.
No. 2 T.B.	G. Red Poll	3,981.00	181.76	4 57	300	Messrs. Tredgold.
No. 17 T.B. ...	do.	4,344 00	206 17	4.75	288	Bros., Cressydale
L.3	do.	4,003.50	180.77	4.52	234	Farm, Lydiate
No. 83 T.B. ...	do.	4,440.50	185.80	4.18	288	

Rhodesia Weather Bureau.

JUNE, 1939.

Pressure.—Monthly mean pressure was generally about 1 mb. above normal.

Temperature.—Mean maximum temperatures were generally very low and minimum temperatures varied from normal to low, the average temperature for the month being about 2° F. below normal.

PRECIPITATION.

Station.	Inches.	Normal.	No. of Days.
Beitbridge	.06	.02	1
Bindura	.11	.06	2
Bulawayo	.02	.03	1
Chipinga	1.21	.66	5
Enkeldoorn	.11	.07	3
Fort Victoria	.30	.09	3
Gwaai Siding	Nil	Nil	—
Gwanda	—	.06	—
Gwelo	.16	.02	4
Hartley	.29	.01	6
Inyanga	.46	.12	3
Marandellas	.66	.09	6
Miami	—	.12	—
Mount Darwin	.08	.04	3
Mount Nuza	1.75	2.48	8
Mtoko	.13	.06	4
New Year's Gift	.75	.41	6
Nuanetsi	.37	.08	3
Plumtree	Nil	Nil	—
Que Que	.15	.01	2

Station.	Inches.	Normal.	No. of Days.
Rusapi	1.08	.29	4
Salisbury	.18	.06	6
Shabani	.10	.16	2
Sinoia	.32	.02	2
Sipolilo	.32	.04	5
Stapleford	2.06	1.21	7
Umtali	.47	.26	5
Victoria Falls	Nil	.01	—
Wankie	Nil	Nil	—

Balovale	Nil	—	—
Broken Hill	Nil	—	—
Fort Roseberry	Nil	—	—
Kasama	Nil	—	—
Kasempa	Nil	—	—
Livingstone	Nil	—	—
Lusaka	Nil	—	—
Mankoya	Nil	—	—
Mkushi	Nil	—	—
Mongu	Nil	—	—
Mufulira	Nil	—	—
Mumbwa	Nil	—	—
Mwinilunga	Nil	—	—
Namwala	0.22	—	2
Ndola	Nil	—	—
Petauke	Nil	—	—
Sesheke	Nil	—	—
Solwezi	Nil	—	—

JUNE, 1939

Station	Altitude (Feet)	Temperature in Stevenson Screen at 4 feet °F: 8-30 a.m. Dry Bulb.	8-30 a.m. Wet Bulb.	8-30 a.m. Dew Point	8-30 a.m. Vapour Press. Deficit	Maximum	Minimum	Max. + Min. ÷ 2	Absolute Maximum	Date	Absolute Minimum	Date	Number of Days: Max. > 85°	Max. < 70°	Min. > 65°	Min. < 40°	Mean of 24 hours	Pressure Millibars: 8-30 a.m. Station Level	8-30 a.m. 1200 gdm.	Mean of 24 hours	Cloud Tenths	Sunshine Hours
Beitbridge...	1,486	56.4	52.4	49	3.6	73.6	46.4	60.0	81	18	39	28	..	2	.	2	59.2	972.9	887.9	...	2.7	...
Bindura...	3,700	56.3	51.3	47	4.6	69.8	44.8	57.3	76	19	38	13	.	13	...	5	56.7	.	...	..	2.8	...
Bulawayo	4,393	52.3	48.3	45	3.3	65.5	43.1	54.3	72	19	39	5	...	25	...	2	53.2	875.2	887.1	873.9	3.5	8.9
Chipinga	3,685	54.6	52.3	51	2.0	63.4	48.2	55.8	74	18	41	28	..	28	...	...	54.3	898.7	887.7	..	4.7	...
Enkeldoorn	4,808	51.8	48.3	45	2.8	64.6	42.6	53.6	72	19	36	5	...	27	...	4	52.1	862.4	886.9	..	4.2	...
Fort Victoria... ...	3,571	48.8	47.2	46	1.3	65.8	42.3	54.0	73	17	36	11	..	21	...	9	54.0	901.8	887.1	900.8	4.0	...
Gwaai Siding... ...	3,278	51.9	48.7	46	2.7	71.8	41.2	56.5	78	17	32	13	...	7	..	12	...	910.6	886.6	...	1.9	...
Gwanda...	3,233	53.8	50.0	47	3.4	67.4	42.5	54.9	75	18	36	13	...	20	...	8	54.6	913.1	887.2	..	2.7	..
Gwelo	4,629	51.6	47.9	45	2.9	63.7	43.5	53.6	72	19	38	11	..	29	...	2	52.1	867.6	886.8		3.6	...
Hartley...	3,879	53.9	49.5	45	3.9	70.1	42.7	56.4	77	19	36	11	..	13	..	9	55.5	891.1	886.5	...	2.4	..
Inyanga...	5,503	54.1	47.8	42	5.4	62.5	42.7	52.6	70	19	37	13	...	29	..	8	50.4	...	.	..	3.3	...
Marandellas	5,453	50.1	46.6	43	2.7	61.8	42.8	52.3	70	19	38	5	..	29	.	5	51.2	...	...	..	4.1	...
Miami	4,090	54.8	51.1	48	3.2	67.6	44.8	56.2	74	19	40	5		20	...	...	54.7	883.8	885.8	882.6	2.6	...
Mt. Darwin	3,179	58.5	54.5	51	3.8	70.6	44.9	57.8	77	19	38	10	...	9	...	6	57.8	...	...	...	3.6	...
Mount Nuza	6,668	43.8	42.7	42	0.8	50.6	39.8	45.2	62	18	34	26	...	30	...	16	44.1	804.7	887.1	...	6.9	...
Mtoko	4,136	56.4	50.9	45	5.0	66.2	47.7	56.9	72	19	42	5	...	26	...	...	55.6	883.0	886.6	882.0	3.1	..
New Year's Gift...	2,690	54.8	52.2	50	2.3	68.8	47.8	58.3	77	18	41	28	...	17	...	.	..	...	...	...	...	.
Nuanetsi	1,547	54.6	52.5	51	1.9	72.6	43.4	58.0	80	18	37	29	...	6	...	6	...	971.0	887.6	...	3.5	...

JUNE, 1939 (continued)

Station	Altitude (Feet)	Temperature in Stevenson Screen at 4 feet °F: 8-30 a.m. Dry Bulb.	8-30 a.m. Wet Bulb.	8-30 a.m. Dew Point	8-30 a.m. Vapour Press Deficit	Maximum	Minimum	Max. + Mim. ÷ 2	Absolute Maximum	Date	Absolute Minimum	Date	Number of Days: Max. > 85°	Max. < 70°	Min. > 65°	Min. < 40°	Mean of 24 hours	Pressure Millibars: 8-30 a.m. Station Level	8-30 a.m. 1200 gdm.	Mean of 24 hours	Cloud Tenths	Sunshine Hours
Plumtree	4,549	54.1	47.7	41	4.5	56.2	45.0	55.6	73	19	41	28	...	23	...	...	53.5	...	...	...	1.0	...
Que Que	3,999	53.8	49.5	46	3.7	69.5	44.6	57.0	76	19	40	12	...	10	...	...	55.7	887.6	886.8	886.2	2.7	...
Rusape	4,648	50.8	48.4	46	2.1	64.2	41.7	53.0	70	13	34	5	...	27	..	14	51.9	.		...	4.4	...
Salisbury	4,831	53.4	48.7	44	4.1	65.8	43.2	54.5	73	19	38	4	...	27	...	5	53.7	861.2	886.7	859.9	3.9	7.9
Shabani	3,131	55.0	51.2	48	3.3	66.9	45.5	56.3	74	18	40	24	...	23	...	...	55.4	...	...	...	4.8	...
Sinoia	3,795	54.6	50.5	47	3.7	71.4	41.4	56.4	78	19	34	10	...	8	...	15		...	...	...	2.6	...
Sipolilo	3,876	57.2	52.3	48	4.4	68.3	45.9	57.1	75	19	37	10	...	21	...	4	..	...	...	...	2.4	..
Stapleford	5,304	48.7	47.4	46	1.1	56.6	38.4	47.5	67	18	29	5	...	30	...	17	46.5	...	...	...	6.2	...
Umtali	3,672	55.3	52.2	49	2.8	66.4	47.4	56.9	76	18	40	5	...	24	...	...	55.1	899.1	887.8	897.8	4.9	...
Victoria Falls... ...	3,009	56.5	51.4	47	4.8	75.9	45.6	60.7	82	19	39	14	...	1	...	2	59.6	..	...	...	2.3	...
Wankie...	2,569	57.2	52.0	47	4.8	77.8	51.3	64.5	85	19	45	12	...	..	...	...	63.4	933.7	..	...	2.2	...
Abercorn	5,458	57.4	53.0	50	4.0	74.0	51.0	62.5	77	14	49	27	...	2	...	...	..	840.2	884.1	...	2.7	...
Broken Hill	3,911	55.9	51.7	48	3.8	70.4	48.0	59.2	78	18	42	11	...	11	...	..	...	888.5	884.7	...	3.4	...
Chipili	3,900	58.4	54.2	51	4.0	77.8	43.6	63.2	82	18	43	11	...	...	...	...	.	...	...	...	..	...
Fort Jameson ...	3,815	59.4	54.5	51	4.7	71.3	53.5	62.4	76	18	49	27	...	8	...	...	...	892.4	885.7	...	3.3	...
Kasama...	4,562	59.8	53.5	48	6.0	73.2	50.9	62.0	78	18	46	27	...	2	...		...	...	...	...	...	...
Kasempa	4,500	54.4	50.2	46	3.7	72.7	44.7	58.7	79	20	36	29	.	5	...	3	...	..	.	...	..	...
Livingstone	3,051	52.8	49.5	47	2.8	74.0	45.7	59.9	80	19	40	16	..	4	...	...	59.1	917.2	885.4	915.6	2.8	...
Lusaka	4,193	57.1	51.8	47	4.9	68.3	48.4	58.4	76	19	43	27	...	20	...	..	...	879.5	884.9	..	4.4	...
Mazabuka	3,385	58.5	53.1	49	5.2	72.4	50.7	61.6	79	18	42	6	...	6	...	...	...	.	...	...	...	...
Mongu	3,481	58.3	52.5	48	5.4	77.5	49.5	63.5	82	19	44	26	...	.	...	...	...	901.5	884.0	...	1.6	...
Mpika	4,620	56.9	53.0	50	3.6	69.4	49.2	59.3	74	18	43	11	...	15	...	...	...	866.1	884.8	...	4.1	...
Mwinilunga	4,450	55.1	51.9	49	2.8	76.5	44.9	60.7	79	18	33	29	...	...	...	4	...	...	...	...	...	...
Ndola	4,190	55.9	51.9	49	3.6	74.1	46.7	60.4	79	1	42	12	...	...	...	...	.	879.1	884.1	...	2.4	...

Southern Rhodesia Veterinary Report.

JUNE, 1939.

DISEASES.

African Coast fever diagnosed on the farm Riversdale, Charter native district.

TUBERCULIN TEST.

Twenty bulls, 26 cows and 9 heifers were tested on importation, two re-actors were destroyed and four doubtful re-actors have been held over for a further test.

MALLEIN TEST.

Seventy-five horses and 24 mules were tested and there were no re-actors.

IMPORTATIONS.

From United Kingdom: 6 bulls.

From Union of South Africa: 18 bulls, 33 cows, 74 horses, 747 sheep.

From Bechuanaland Protectorate: 1 horse, 239 slaughter oxen, 1,114 sheep.

EXPORTATIONS.

To Union of South Africa: 411 oxen, 72 cows.

To Portuguese East Africa: 149 cattle.

To Northern Rhodesia: 24 donkeys.

EXPORTATIONS—MISCELLANEOUS.

To United Kingdom: Chilled beef quarters, 4,908; frozen boneless beef quarters, 608; pancreas, 143 lbs.; tongues, 2,402

lbs.; livers, 17,879 lbs.; hearts, 4,453 lbs.; skirts, 2,852 lbs.; shanks, 4,639 lbs.; spinal cords, 15 lbs.

To Belgian Congo: Beef carcases, 192½; mutton carcases, 36; veal carcases, 10; offal, 425 lbs.

Meat Products from Liebig's Factory.

To Union of South Africa: Corned beef, 64,428 lbs.

To Bechuanaland Protectorate: Corned beef, 180 lbs.

To Basutoland: Corned beef, 4,080 lbs.

S. A. Myhill,
Chief Veterinary Surgeon.

SOUTHERN RHODESIA

Locust Invasion, 1932-39.

Monthly Report No. 79. June, 1939.

Very few reports of locusts have been received during June, possibly owing to the cold weather inhibiting activity.

Large swarms of the Red Locust (*Nomadacris septemfasciata*, Serv.) have, however, been observed in the districts of Inyanga, Victoria, Chibi and Bulalima-Mangwe.

Solitary fliers of this species were noted in considerable numbers in open grass land on a hill-top in the southern Melsetter district in June.

RUPERT W. JACK,
Chief Entomologist.

Departmental Bulletins.

Copies of these Bulletins may be obtained from the Editor, Box 387, Salisbury. They are issued free to residents of Southern Rhodesia and a charge of 3d. per copy is made in all other cases.

N.B.—The date the article appeared in the Journal is indicated in abbreviated form before the number, e.g., 8/22, No. 429, means that Bulletin 429 appeared in the Journal for August, 1922.

AGRICULTURE AND CROPS.

7/25. No. 545. Artificial or Synthetic Farmyard Manure, by H. G. Mundy, Dip.Agric., F.L.S.

5/27. No. 643. Noxious Weeds in Southern Rhodesia, by F. Eyles, Botanist.

12/27. No. 663. The Use of Fertilisers and Manures in Southern Rhodesia, by A. D. Husband, A.I.C., Chief Chemist.

2/28. No. 674. Top Dressing of Maize against Stalk Borer, by H. C. Arnold.

3/28. No. 681. The Sunflower (Helianthus Annuus) (Revised), by S. D. Timson, M.C., Dip.Agric.

6/28. No. 695. The Castor Oil Plant (Ricinus spp.), by S. D. Timson, M.C., Dip.Agric.

9/28. No. 705. Suggested Cropping Programmes for Farms on the Sand Veld, by D. E. McLoughlin, Assistant Agriculturist.

10/28. No. 710. Monthly Reminders for the Farming Year, by the Division of the Chief Agriculturist.

3/29. No. 727. Farmyard Manure, by A. P. Taylor, M.A., B.Sc., Agricultural Chemist.

3/29. No. 732. Two Common Diseases of Potato Tubers in Rhodesia, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A.

7/29. No. 743. Sunn Hemp, by S. D. Timson, M.C., Dip.Agric.

9/29. No. 751. The Sweet Potato, by S. D. Timson, M.C., Dip.Agric. (Wye).

10/29. No. 758. Instructions for Taking Soil Samples. Issued by the Division of Chemistry.

1/30. No. 768. The Ground Nut (Arachis hypogaea), by S. D. Timson, M.C., Dip.Agric. (Wye).

3/30. No. 776. Regulations Governing the Export of Maize and Maize Meal through the Port of Beira.

11/30. No. 797. Green Manuring: An Essential Practice in Rhodesian Farming, by H. G. Mundy, Dip.Agric. (Wye), F.L.S., Chief Agriculturist.

1/31. No. 802. Witch Weed, by S. D. Timson, M.C., Inter.B.Sc. (Agric.) London., Dip.Agric (Wye), Assistant Agriculturist.

3/31. No. 815. New Strains of Oats for Southern Rhodesia, by H. C. Arnold, Manager, Agricultural Experiment Station, Salisbury.

4/31. No 816. Preliminary List of the more Common Grasses of Southern Rhodesia, by Sydney M. Stent, Botanist for Pasture Research.

5/31. No. 822. Re-stacking of Maize rejected for Export on account of Excessive Moisture.

9/31. No. 826. Some Poisonous Plants of Southern Rhodesia, by Sydney M. Stent, Senior Botanist.

10/31. No. 831. Revised Notes on Cotton Growing in Southern Rhodesia, by G. S. Cameron.

11/31. No. 836. The Potato, by S. D. Timson, M.C., Dip.Agric. (Wye).

12/31. No. 837. Veld Grass Silage: A Feature in Rhodesian Pasture Management, by H. G. Mundy, Dip.Agric. (Wye), F.L.S., Chief, Division of Plant Industry.

6/32. No. 855. Pigeon-hole Method of Stacking Maize, by Division of Plant Industry.

8/32. No 859. Twenty-one Years of Plant Introduction, by Major Mundy, Chief Division of Plant Industry.

2/33. No 878 A.I.V. Silage: Memorandum prepared and circulated by Imperial Bureau of Animal Nutrition.

11/34 No. 936. Witchweed, by S. D. Timson, M.C. Dip.Agric. (Wye), Assistant Agriculturist.

10/35 No. 970 Rhodes Grass for the Southern Rhodesian Tobacco Grower, by African Explosives and Industries, Ltd.

11/35. No 972. Notes on Witchweed, by S. D. Timson, M.C , Dip.Agric. (Wye), Assistant Agriculturist.

6/36 No. 992. Annual Report of the Agriculturist for the year 1935, by D E. McLoughlin, Agriculturist.

8/36. No. 997. Reward Wheat: Report on the Baking Properties and Chemical Analyses, by The Rhodesian Milling and Manufacturing Co., Ltd.

4/37. No. 1022. Smut Diseases of Wheat in Southern Rhodesia, by G. M. Wickens, B.Sc. Agric., Ph.D., D.I.C., Plant Pathologist, Tobacco Research Station, Trelawney.

9/37. No. 1044. Farming Calendar.

10/37. No. 1046. Green Manuring: Two Important Factors Affecting Success, by S. D. Timson, M.C., Assistant Agriculturist, and H. C. Arnold, Manager, The Agricultural Experiment Station.

10/38. No. 1084. Improved Pastures, by S. D. Timson, M.C., Assistant Agriculturist.

11/38. No. 1089. Witchweed and the Labour Shortage, by S. D. Timson, M.C., Assistant Agriculturist.

2/39. No. 1101. Grass Silage, by H. C. Arnold, Manager, Salisbury Experiment Station

4/39. No. 1104. Compost, by S. D. Timson, M.C., Assistant Agriculturist. Revised February, 1939.

REPORTS ON CROP EXPERIMENTS.

7/27. No. 649. Annual Report of Experiments, 1925-26, Agricultural Experiment Station, Salisbury, by H. C. Arnold, Manager.

4/28. No. 683. Annual Report of Experiments, 1926-27, Agricultural Experiment Station, Salisbury, by H. C. Arnold, Station Manager.

7/29. No. 745. Salisbury Agricultural Experiment Station Annual Report, 1927-28, by H. C. Arnold.

7/30. No. 789. Agricultural Experiment Station, Salisbury. Annual Report of Experiments, 1928-29, by H. C. Arnold.

9/31. No. 830. Salisbury Agricultural Experiment Station, Annual Report, 1929-30, by H. C. Arnold, Manager.

10/32. No. 864. Annual Report, 1930-31: Agricultural Experiment Station, by H. C. Arnold, Station Manager.

6/33. No. 895. Salisbury Agricultural Experiment Station Annual Report, 1931-32, by H. C. Arnold, Manager.

3/34. No. 914. Gwelo Municipal Demonstration Station: Final Report, 1933, by S. D. Timson, M.C., Dip.Agric (Wye), Assistant Agriculturist.

9/35. No 965. Salisbury Agricultural Experiment Station Annual Report, 1933-34, by H. C. Arnold, Manager.

6/39. No. 1113. Wheat Production in Southern Rhodesia, by D. E. McLoughlin, Agriculturist.

5/39. No. 1110. The Management and Utilisation of Natural Pastures, by H. C. Arnold, Manager, Salisbury Experiment Station.

TOBACCO.

8/26. No. 605. Flue-curing Tobacco Barns, Bulking and Grading Sheds, by P. H. Haviland, B.Sc. (Eng.), Acting Government Irrigation Engineer.

9/26. No. 615. The Culture of Virginia Tobacco in Southern Rhodesia: Field Management, by D. D. Brown.

5/27. No. 641. The Handling, Grading and Baling of Cured Virginia Tobacco, by D. D. Brown.

5/27. No. 644. Tobacco Baling Boxes, by B. G. Gundry, Irrigation Branch.

9/27. No. 653. The Care of Tobacco Seed Beds, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A. (Trinidad)

11/27. No 661. Flue-curing Tobacco Barns, 12 ft. x 12 ft. x 16 ft., by B. G. Gundry.

1/28. No. 665. Tobacco Pests of Rhodesia, by Rupert W. Jack, F.E.S., Chief Entomologist.

2/28. No. 671. Wildfire and Angular Spot of Tobacco, by J. C. F. Hopkins, B.Sc., A.I.C.T.A.

12/28. No. 715. Turkish Tobacco Culture in Southern Rhodesia, by D. D. Brown, Chief Tobacco Expert.

3/29. No. 728. Suggested Crop Rotations for Tobacco Growers, by D. D. Brown, Chief Tobacco Expert.

4/29. No. 734. Common Faults in Curing Virginia Bright Tobacco, by D. D. Brown, Tobacco and Cotton Expert.

8/29. No. 748. Frog Eye Disease of Tobacco, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A., Chief Botanist and Mycologist.

9/29. No. 753. Leaf Spotting of Tobacco caused by Mosaic, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A., Chief Botanist and Mycologist.

2/30. No. 771. Dark Fire-cured Tobacco: Field Operations, by D. D. Brown, Chief Tobacco Expert.

3/30. No. 774. Dark Fire-cured Tobacco: Harvesting and Curing, by D. D. Brown, Chief Tobacco Expert.

6/30. No. 784. Field Control of Frenching in Tobacco, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A., Plant Pathologist.

3/31. No. 812. Selection of Tobacco Seed Plants, by H. F. Ellis, M.Sc., B.S. (Agric.), Tobacco Adviser.

11/31. No. 835. Tobacco Culture: Transplanting Operations, by D. D. Brown.

3/32. No. 846. Leaf Curl in Tobacco, by Dr. H. H. Storey.

3/33. No. 885. Tobacco Culture in Southern Rhodesia: The Harvesting and Curing of Virginia Tobacco, by D. D. Brown, Chief Tobacco Officer.

8/36. No. 996 The "Gundry" Tobacco Furnace, by B. G. Gundry, A.I.Mech.E.

12/36 No. 1009. Tobacco Research on the Trelawney Station 1935-36 Season.

4/37. No. 1025. Report of the Tobacco Research Board, by Chas. K. Brain, M.A., D.Sc., Director of Agriculture and Chairman of the Tobacco Research Board.

5/37. No. 1026. Notes on Tobacco Root-Knot Nematode, by J. C. Collins, B.Sc., Biologist, Trelawney Tobacco Research Station.

8/37. No. 1039. Some Tobacco Pests that can be serious, by M. C. Mossop, M.Sc., Entomologist, Department of Agriculture.

1/38. No. 1054. Alkalinity of Tobacco Seed-bed Soils, by A. P. Taylor, M.A., B.Sc., Agricultural Chemist.

3/38 No. 1063. A New and Serious Disease of Tobacco in Southern Rhodesia, by G. M. Wickens, Ph.D., D.I.C., Plant Pathologist, Tobacco Research Station, Trelawney.

5/38 No. 1070 A Witchweed on Tobacco Roots (*Striga orobanchoides*, Benth.), by Chas. K. Brain, M.A., D.Sc., Director of Agriculture.

6/38. No 1072 Report of the Tobacco Research Board for the year ending 31st December, 1937, by Chas. K. Brain, M.A., D.Sc., Director of Agriculture, and Chairman of the Tobacco Research Board.

LIVE STOCK

1/27. No 624. The Construction of Dipping Tanks for Cattle (Revised).

1/31. No. 801. Sheep Farming in the Melsetter District, by J. C. Kruger, Part-time Sheep Adviser in the Melsetter District.

10/32. No. 863. Piggeries, by B. G. Gundry, A.I.Mech.E.

12/32. No. 871. Some General Observations on the Feeding of Dairy Cows on a Mixed Stock Farm, by Dr A. E. Romyn, Senior Animal Husbandry Officer.

4/33. No 887. The Type of Chiller Steer required for Export, by A. E. Romyn, Senior Animal Husbandry Officer.

9/33. No. 903. The Handling, Preparation and Chilling of Cattle for Export, by C. A. Murray, Lecturer in Animal Husbandry.

12/33. No. 907 The Blackhead Persian: Its Breeding and Management in Matabeleland, by C. A. Murray, M.Sc., Lecturer in in Animal Husbandry, Matopo Estate.

1/34. No. 909. Stall Fed Chillers for the Overseas Christmas Market, by C. A. Murray, M.Sc., Animal Husbandry Officer, Matopo School of Agriculture and Experiment Station, Rhodes Matopo Estate.

2/34. No 912. Economical Winter Rations for Wintering Dairy Heifers, by C. A. Murray, M.Sc. (Agric), Lecturer in Animal Husbandry, Matopo School of Agriculture.

4/34. No. 916. Cowpea Hay in the Ration for Bacon Pigs, by C. A. Murray, M.Sc. (Agric.), Lecturer in Animal Husbandry, Matopo School of Agriculture and Experiment Station.

6/34. No. 924. Raising Dairy Calves on a Limited Amount of Whole Milk, by C. A. Murray, M.Sc., Agr., Animal Husbandry Officer, Matopo School of Agriculture and Experiment Station, Rhodes Matopo Estate.

1/35. No. 943. Cattle Improvement and a Cattle Breeding Policy in Southern Rhodesia: A Review of the General Position Chiefly as regards Ranching Cattle, by Dr. A. E. Romyn, Chief Animal Husbandry Officer.

1/35. No. 945. A Home-made Cow Stanchion, by Major R. R. Sharp, Whinburn, Redbank.

3/35 No. 946. Economical Rations for Wintering Dairy Cattle, by C. A. Murray, M.Sc. (Agric.), Senior Animal Husbandry Officer in Charge, Matopo School of Agriculture and Experiment Station.

5/35. No 952. Annual Report of the Chief Animal Husbandry Officer for the year ending 31st December, 1934, by A. E Romyn, Chief Animal Husbandry Officer.

7/35. No. 959. The Selection of a Dairy Bull, by A. E. Romyn, Ph.D., Chief Animal Husbandry Officer.

4/36. No. 984. Report on the Curing of Rhodesian Hides, by Advisory Committee on Hides and Skins of the Imperial Institute.

4/36. No 985. Export of Frozen Porkers. Third Consignment to Smithfield. Division of Animal Husbandry.

5/36. No. 987. The Curing of Hides and Skins on the Farm, by The Division of Animal Husbandry.

5/36. No. 988. Preparing Cattle for Show, by The Animal Husbandry Division.

6/36. No. 989 The Supplementary Feeding of Mineral and Protein Supplements to Growing Cattle in Southern Rhodesia and its Relation to the Production of Beef Steers, by C. A. Murray, M Sc. (Agric.), Senior Animal Husbandry Officer in Charge, Rhodes Matopo Estate; A. E Romyn, Ph.D., Chief Animal Husbandry Officer, Department of Agriculture, Southern Rhodesia; D. G Haylett, Ph.D., Director, Rhodes Matopo Estate; F. Ericksen, Dip. Agric., Experimentalist.

10/36. No. 1001. The Raising of Bacon Pigs, by A. E. Romyn, Chief Animal Husbandry Officer, and C. A. Murray, Senior Animal Husbandry Officer in Charge, Rhodes Matopo Estate, with a Veterinary Section by D. A. Lawrence, Director of Veterinary Research.

9/36. No. 1000. Sheep Management on the Mixed Farm, by R. H. Fitt, Animal Husbandry Officer.

4/37. No. 1023. Cowpea Molasses Silage for Fattening Steers, by C A. Murray, M.Sc. (Agric.), Senior Animal Husbandry Officer in Charge, Matopo School of Agriculture and Experiment Station; A. E. Romyn, Ph.D., Chief Animal Husbandry Officer, Department of Agriculture, Salisbury; R. H. Fitt, Dipl. Agric., Animal Husbandry Officer, Department of Agriculture, Salisbury.

4/37. N. 1024. Comparative Feeding Value of Maize Meal and Nyouti (*Pennisetum Typhoides*) Meal for Fattening Steers, by C. A. Murray, Senior Animal Husbandry Officer in Charge, Rhodes Matopo Estate; A. E. Romyn, Chief Animal Husbandry Officer.

5/37. No. 1027. The Feeding of Phosphorus Supplements to Growing Cattle by C. A Murray and A E Romyn.

5/37. No 1029. The Dehorning of Cattle intended for Slaughter and Export, by B. A. Myhill, Assistant Chief Veterinary Surgeon.

5/37. No. 1030. The Feeding of Different Winter Supplements to young growing steers and the effect of these supplements on the subsequent development and costs of production of the steers, by C. A. Murray and A. E. Romyn.

6/37. No. 1032. The Effects of Feed on the Firmness and Grading of Bacon Carcases, an experiment carried out by the Division of Animal Husbandry in co-operation with Mr. A. L. Millar, Estes Park, Salisbury, and Mr. Frank Neill, of Neill's Bacon Factory, Salisbury.

6/37. No. 1034. Nyouti or Munga (*Pennisetum typhoides*) as a Feed for Bacon Pigs, by C. A. Murray and A. E. Romyn.

7/37. No. 1036. Preliminary Report on the Feeding of Winter Supplements to young growing steers and the effect of supplementary feeding on the subsequent development of these animals, by C. A. Murray and A. E. Romyn.

12/37. No. 1049. The Export of Frozen Porkers: Report on Five Consignments of Porkers Exported to Smithfield, by Division of Animal Husbandry.

1/38. No. 1053. The Feeding of Sunnhemp Hay as compared with Cowpea Hay in the Fattening Ration for Bullocks, by A E. Romyn and R H. Fitt

2/38. No. 1058. Pig Industry Act, 1937. Division of Animal Husbandry.

9/38. No. 1083. Internal Parasites in Sheep, by Percy D. Huston, M.R.C.V.S., District Veterinary Officer.

11/38. No. 1091. Cost of Fattening Bullocks of various ages in Matabeleland, by A. E. Romyn and C. A. Murray.

7/39. No. 1120. Urea as a possible substitute for Peanut Cake for Wintering Young Stock, by C A. Murray and A. E Romyn.

6/39 No. 1115. Feeding Young Stock in Winter, by C A. Murray, M.Sc (Agr.) and A. E Romyn, Ph.D., Division of Animal Husbandry, Department of Agriculture, Southern Rhodesia

DAIRYING.

12/30. No. 799. The Objects of Ripening Cream for Butter-making, and a few Hints on Cream Production, by F. Lammas, Dairy Officer.

9/32. No. 862. Cream Cheese, by F. A. Lammas, Dairy Officer.

3/33. No. 880. Dairy Tests and Calculations, by F. A. Lammas, Dairy Officer.

5/34. No. 922. Dairy Building in Southern Rhodesia: A Small Farm Dairy, by G. B. Gundry, A.I.Mech.E.

7/34. No. 926. Dairy Buildings in Southern Rhodesia. Cow Byre—Type II., by B. G. Gundry, A.I.Mech.E.

12/34. No 937. Gouda or Sweet Milk Cheese, by F. Lammas, District Dairy Officer.

2/36. No. 977. Notes on the Feeding of Dairy Cows during the Summer Months, by A. E. Romyn, Chief Animal Husbandry Officer.

6/36. No. 990. Southern Rhodesia Milk Recording Scheme.

12/37. No. 1051. The Production and Handling of Milk and Cream, by the Dairy Branch.

12/38. No. 1094. Farm Butter Making, by The Dairy Branch.

VETERINARY.

10/14. No. 191. Scab or Scabies in Sheep and Goats, by Rowland Williams, M.R.C.V.S.

12/25. No. 570. The Spaying of Bovines, by G. C. Hooper Sharpe, M.C., M.R.C.V.S., and M. H. Kingcombe, M.R.C.V.S.

6/26. No. 597. Suspected Poisoning of Stock: The Proper Procedure, by M. H. Kingcombe, M.R.C.V.S. (Lond.), and A. W. Facer, B.A. (Oxon.), A.I.C.

12/26. No. 618. Notes from the Veterinary Laboratory: Quarter Evil, by Ll. E. W. Bevan, M.R.C.V.S., Director of Veterinary Research.

1/28. No. 666. Notes from the Veterinary Laboratory: Praemonitus—Praemunitus, by Ll. E. W. Bevan, M.R.C.V.S., Director of Veterinary Research.

10/29. No. 756. Parasitic Gastritis of Cattle, by Ll. E. W. Bevan, M.R.C.V.S., Director of Veterinary Research.

11/29. No. 760. A Note on Sheep Diseases in Southern Rhodesia, by D. A. Lawrence, B.V.Sc., Veterinary Research Officer, Department of Agriculture, Salisbury.

2/30. No. 772. Notes from the Veterinary Laboratory: Ophthalmia, by Ll. E. W. Bevan, M.R.C.V.S., Director of Veterinary Research.

4/31. No. 819. Measles in Swine, by P. D. Huston, M.R.C.V.S.

1/32. No. 841. Poisonous or Suspected Poisonous Plants of Southern Rhodesia: Tulip Poisoning of Cattle, by Sydney M. Stent, Senior Botanist, and D. A. Lawrence, B.V.Sc., Veterinary Research Officer.

10/32. No. 866. The Treatment of Intestinal Parasites of Sheep, by J. D. Coutts, D.V.S., M.R.C.V.S.

4/33. No. 886. A Preliminary Note on Contagious Granular Vaginitis in Southern Rhodesia, by D. A. Lawrence, B.V.Sc., Acting Director Veterinary Research.

IRRIGATION, WATER SUPPLIES AND SOIL EROSION.

4/27. No. 640. Levelling for Irrigation, by Dr. W. S. H. Cleghorn, M.I.Mech.E.

11/27. No. 659. The Hydraulic Ram, revised by P. H. Haviland, B.Sc.

11/28. No. 668. The Water Act, 1927, by C. L. Robertson, B.Sc. (Eng.), A.M.I.C.E.

1/28. No. 670. Irrigation Canals, by P. H. Haviland, B.Sc. (Eng.).

6/30. No. 786. Low Concrete Dams, by R. Hamilton Roberts, B.Sc. (Eng.), Assistant Irrigation Engineer.

2/31. No. 808. The Application of Water in Irrigation, by R. Hamilton Roberts, B.Sc. (Eng.), Assistant Irrigation Engineer.

3/31. No 811. Irrigation Canal Structures, by R. H. Roberts, B.Sc. (Eng.), Assistant Irrigation Engineer.

8/32. No. 860. Soil Drainage and Utilisation of Vleis, by R. H. Roberts, B.Sc. (Eng.), Assistant Irrigation Engineer.

2/33. No. 879. Conditions Governing the Hire of Government Boring Machines.

6/35. No 956. Annual Report of the Division of Irrigation for the year ended 31st December, 1934, by P. H. Haviland, B.Sc. (Eng.), Acting Chief Irrigation Engineer.

9/35. No 964. The Use of Ditchers for Constructing Contour Ridges, by C. Tapson, Devondale, Concession.

9/35. No. 967 How to use an Engineer's or Farm Level, by P. H Haviland, B.Sc. (Eng.), A.M.I.C E, Irrigation Engineer (Matabeleland).

12/35 No 973. Domestic Water Supplies and Sanitation on the Farm, by P. H. Haviland, B.Sc. (Eng), A.M.I.C.E.. Irrigation Engineer (Matabeleland).

3/36 No. 980 Results from Glenara Soil Conservation Experiment Station, 1934-35 Season, by C. L. Robertson, B.Sc A.M.I.C E., Chief Engineer, Irrigation Division, and A. D. Husband, F.I.C., Chief Chemist.

8/36. No. 999. Lining an Irrigation Furrow, by R. H. Roberts, B.S.. A.M.Inst.C.E., Assistant Irrigation Engineer.

1/38. No. 1052 Small Earthen Storage Dams. Part I. By the Irrigation Division.

2/38. No 1055. Small Earthen Storage Dams. Part II. By the Irrigation Division.

3/38. No. 1061 Soil Drainage and Utilisation of Vleis, by R. H. Roberts, B.Sc. (Eng.), Assistant Irrigation Engineer.

7/38. No. 1077. A Small Brick Irrigation Furrow, by H. W. H. Wallis, Assistant Irrigation Engineer.

1/39. No. 1095. Soil and Water Conservation, by D. Aylen, for the Irrigation Division.

FORESTRY.

11/29. No 763. The Utilisation of Wood, by T. L. Wilkinson, M.Sc., B.Sc F.

1/30. No. 769. The Utilisation of Wood, by T. L. Wilkinson, M.Sc., B Sc.F.

4/30. No. 778 The Utilisation of Wood in Southern Rhodesia—Conversion and Disposal of Timber, by T. L. Wilkinson, M Sc, B.Sc.F., District Forest Officer.

8/30. No 791. The Utilisation of Wood in Southern Rhodesia: Fencing, by T. L. Wilkinson, M Sc., B.Sc F., District Forest Officer.

2/31. No 809 Establishing Pines: Preliminary Observations on the Effects of Soil Inoculation Issued by the Division of Forestry.

7/32. No. 857. Charcoal Burning on the Farm, by R J. Allen, Forester, Rhodes Matopo School of Agriculture and Experiment Station.

11/32. No 869 Wind-breaks and Shelter Belts, by A. A. Pardy, B.Sc., Forestry.

1/33. No. 874. Tree Planting, by the Division of Forestry.

4/33. No. 888. The Vegetable Ivory Palm (Hyphoene ventricosa), by G. M. McGregor, B.Sc., District Forest Officer, Matabeleland.

8/34. No 927. Some Facts about Tung Oil, by R. H. Finlay, B.A, Dip. For. (Oxon.), District Forest Officer.

8/34. No. 928. Some Trees, Shrubs, Shrubby-Herbaceous Plants, Climbers and Water Plants suitable for the Colony, by J. W. Barnes, Manager, Government Forest Nursery, **Salisbury**.

12/35. No. 974. Summary of the Annual Report of the Division of Forestry for the year 1934, by E. J. Kelly-Edwards, M.A., Dip. For. (Oxon.), Chief Forest Officer.
Price List of Forest-tree Transplants, Ornamental Trees Shrubs, Hedge Plants, Creepers and Seeds obtainable at the Government Forest Nursery, Salisbury.

3/37. No. 1020. The Raising of Forest Seedlings and Transplants on the Farm, by E. J. Kelly Edwards, M.A., Dip. For. (Oxon.), Conservator of Forests.

10/37. No 1045. Seventeenth Annual Report of the Division of Forestry for the Year 1936, by E. J. Kelly Edwards, M.A., Dip. For. (Oxon.), Conservator of Forests.

6/38 No. 1073. Pruning of Plantations, by R. H. Finlay, B.A., Oxon., Division of Forestry.

7/38 No 1076. Eighteenth Annual Report of the Division of Forestry for the year 1937, by E. J. Kelly Edwards, M.A., Dip. For. (Oxon.), Conservator of Forests.

10/38 No. 1085. The Pot Planting of Eucalypts, by Major G. R. Wake, Vigila, Umvukwes.

11/38. No. 1087. The Raising and Planting of Trees on the Farm, by E. J. Kelly Edwards, M.A., Dip. For. (Oxon), Conservator of Forests.

HORTICULTURE

4/27 No 637. Harvesting, Packing and Marketing of Deciduous and Tropical Fruits, by G. W. Marshall, Horticulturist.

8/27. No. 650. Coffee Culture in Southern Rhodesia, by G. W. Marshall, Horticulturist.

2/29 No 725 Investigations into "Collar-Rot" Disease of Citrus, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A. (Trinidad)

11/31. No. 834. Celery Culture, by G. W. Marshall, Horticulturist.

2/33. No. 876. Notes on African Aloes (Parts 1-6), by H. Basil Christian, "Ewanrigg," Arcturus.

10/33 No. 905. Notes on African Aloes (Parts 7-10), by H. Basil Christian, "Ewanrigg," Arcturus.

5/34. No. 920. Citrus Fruit Growing in Rhodesia, by G. W. Marshall, Horticulturist.

5/37. No. 1028. Tomato Culture in Southern Rhodesia, by G. W Marshall, Horticulturist.

2/39. No 1100. The Rhodesian Home Orchard, by G. W Marshall, Horticulturist.

ENTOMOLOGY AND PLANT PATHOLOGY.

2/13 No. 139. Termites, or "White Ants," by Rupert W. Jack, F.E.S

6/15. No. 214. Some Household Insects, by R. Lowe Thompson, B.A

2/21. No 385. The Common Fruit Beetle, by R. W. Jack, F.E.S.

12/24 No. 522 Notes on the Black Citrus Aphis, by C. B. Symes.

8/25. No. 548. Insect Pests of Cotton, by C. B. Symes.

9/27 No. 653. The Care of Tobacco Seed Beds, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A. (Trinidad).

1/28. No. 665. Tobacco Pests of Rhodesia, by Rupert W. Jack, F.E.S., Chief Entomologist.

2/28. No. 671. Wildfire and Angular Spot of Tobacco, by J. C. F. Hopkins, B.Sc., A.I.C.T.A.

5/28. No 696. Ticks Infesting Domestic Animals in Southern Rhodesia, by Rupert W. Jack, F.E.S., Chief Entomologist.

11/28. No. 714. Trap Cropping against Maize Pests, by Rupert W. Jack, F.E.S., Chief Entomologist.

12/28. No. 718. Preliminary Experiments on the Control of White Mould of Tobacco, by J. C. F. Hopkins, B.S. (Lond.), A.I.C.T.A., Chief Botanist and Mycologist.

3/29. No. 732. Two Common Diseases of Potato Tubers in Rhodesia, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A.

6/29 No. 742. What is Diplodia in Maize? An Answer to a Popular Question To-day, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A., Chief Botanist and Mycologist.

8/29. No. 748. Frog Eye Disease of Tobacco, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A., Chief Botanist and Mycologist.

9/29. No. 753. Leaf Spotting of Tobacco caused by Mosaic, by J. C. F. Hopkins, B.Sc (Lond), A.I.C.T.A., Chief Botanist and Mycologist.

9/29. No. 754. "Pinking" of Maize: Report of a Preliminary Investigation, by T. K. Sansom, B.Sc., Plant Breeder.

6/30. No. 784. Field Control of Frenching in Tobacco, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A., Plant Pathologist

6/30 No 788. A List of Plant Diseases Occurring in Southern Rhodesia, by J. C. F. Hopkins, B Sc. (Lond.), A.I.C.T A., Plant Pathologist.

A List of Plant Diseases Occurring in Southern Rhodesia, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A., Plant Pathologist. Supplement No. 1.

7/30. No. 790 Notes on the Control of Some of the More Important Insect Pests of Citrus in Southern Rhodesia, by W. J Hall, Ph.D., B.Sc., Entomologist to the British South Africa Company in Southern Rhodesia.

10/30 No. 796. The Army Worm (Laphygma exempta, Wlk.), by Rupert W. Jack, Chief Entomologist.

11/30. No. 798. The Preparation of Bordeaux Mixture and Seasonal Notes on Tobacco Diseases, by J. C. F. Hopkins, B Sc. (Lond.), A.I.C.T.A.

1/31. No. 804. Locusts in Southern Rhodesia, by Rupert W. Jack, Chief Entomologist.

8/31 No. 825. Some Common Diseases of Potatoes in Southern Rhodesia, by J. C. F. Hopkins, B.Sc. (Lond.), Plant Pathologist.

3/32. No 848 Mycological Notes: Seasonal Notes on Tobacco Diseases: 3, Frog Eye; 4. White Mould; by J. C. F. Hopkins, B.Sc. (Lond.).

4/32 No. 850. Pests of Stored Tobacco in Southern Rhodesia, by M. C Mossop, M.Sc., Entomologist.

6/32. No. 856. A List of Plant Diseases occurring in Southern Rhodesia, Supplement 2, by J. C. F. Hopkins, B.Sc. (Lond.), Government Plant Pathologist.

9/32. No. 861. Further Notes on Leaf Curl of Tobacco in Southern Rhodesia, by J. C. F. Hopkins, B.Sc. (Lond.), Plant Pathologist.

11/32. No. 868. Cultural Methods and Tobacco Whitefly in Southern Rhodesia, by M. C. Mossop, M.Sc., Entomologist.

5/33. No. 892. The Tsetse Fly Problem in Southern Rhodesia, by R. W. Jack, Chief Entomologist.

5/33. No. 893. Experiments with Tsetse Fly Traps against Glossina Morsitans in Southern Rhodesia, by R. W. Jack, Chief Entomologist.

6/33. No. 894. Mycological Notes. Seasonal Notes on Tobacco Diseases. 6. An Unusual Type of Frog Eye Spotting, by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A., Government Plant Pathologist.

6/33. No. 896. A List of Plant Diseases occuring in Southern Rhodesia. Supplement 3. (New Records for period June, 1932, to May, 1933.) Compiled by J. C. F. Hopkins, B.Sc. (Lond.), A.I.C.T.A., Government Plant Pathologist.

7/33. No. 897. The Report of the Chief Entomologist for the year ending 31st December, 1932, by Rupert W. Jack, F.E.S., Chief Entomologist.

8/33. No. 899. The Black Maize Beetle (Heteronchus Licus Klug), by C. B. Symes.

2/34. No. 911. Screw Worm. A Pest of Ranch Cattle in Southern Rhodesia, by A. Cuthbertson, Entomologist. Foreword by R. W. Jack, Chief Entomologist.

3/34. No. 913. Locusts: Instructions for dealing with Flying Swarms, by The Division of Entomology.

4/34. No. 917. The Life History of the Screw-worm Fly, by Alexander Cuthbertson, Entomologist.

10/34. No 934. Mycological Notes. Seasonal Notes on Tobacco Diseases. 7, Spraying in Seed-beds and Lands, by J. C. F. Hopkins, D.Sc. (Lond.). A.I.C.T.A., Senior Plant Pathologist.

12/34. No. 938. The Destruction and Control of Locust Hoppers, by R. W. Jack, Chief Entomologist.

1/35. No. 942 Mycological Notes. Seasonal Notes on Tobacco Diseases. 8, The Mosaic Mystery. 9, Danger Points in Field Spraying, by J. C. F. Hopkins, D.Sc. (Lond.), A.I.C.T.A., Senior Plant Pathologist.

4/35. No. 950. The Control of Tsetse Fly in Southern Rhodesia, by Rupert W. Jack, Chief Entomologist.

4/35. No 951. Suspected "Streak" Disease of Maize. Notice to Growers, by J. C. F. Hopkins, D.Sc. (Lond.), A.I.C.T.A., Senior Plant Pathologist.

6/35. No. 957. Annual Report of the Branch of Plant Pathology for the year ending 31st December, 1934, by J. C. F. Hopkins, D.Sc. (Lond.), A.I.C.T.A., Senior Plant Pathologist.

8/35. No. 962. The Report of the Chief Entomologist for Year ending 31st December, 1934, by R. W. Jack, Chief Entomologist.

10/35. No 969 The Objects and Value of Seed Treatment of Maize against Diplodia, by G. M. Wickens, Ph.D. (Lond.), D.I.C., Assistant Plant Pathologist.

5/36. No 986. Annual Report of the Division of Entomology for year ending 31st December, 1135, by Rupert W. Jack, Chief Entomologist.

7/36. No. 993. Annual Report of the Senior Plant Pathologist for year ending 31st December, 1935. Part I.: Plant Pathology. Part II.: Tobacco Research, by J. C. S. Hopkins, D.Sc. (Lond.), A.I.C.T.A., Senior Plant Pathologist and Officer in Charge of Tobacco Research Station, Trelawney.

12/36. No. 1011. Tick Infesting Domestic Animals in Southern Rhodesia, by Rupert W. Jack, Chief Entomologist. Revised, November, 1936.

7/37.	No. 1037.	Division of Entomology: Annual Report for year 1936, by R. W. Jack, Chief Entomologist.
8/37.	No. 1040.	A Programme for the Control of Diseases of Apple Trees in Southern Rhodesia, by J. C. F. Hopkins, D.Sc. (Lond.), A.I.C.T.A., Senior Plant Pathologist.
10/37.	No. 1047.	Mycological Notes: Seasonal Notes on Tobacco Diseases. X.: Precautionary Methods in Seed-beds, by J. C. F. Hopkins, D.Sc. (Lond.), A.I.C.T.A., Senior Plant Pathologist.
12/37.	No. 1050.	An Unusual Winter Outbreak of Maize Weevil *Calandra oryzae*, L.), by M. C. Mossop, M.Sc., Entomologist, Department of Agriculture.
2/38.	No. 1059.	A Poison Bait for Young Locust Hoppers.
6/38.	No. 1071.	Common Diseases of Apples and their Control in Southern Rhodesia, by J. C. F. Hopkins. D.Sc. (Lond.), A.I.C.T.A., and Aline L. Bacon, B.Sc., Division of Plant Pathology.
6/38.	No. 1074.	A Note on a Stem Rot of Sweet Peas, by J. C. F. Hopkins, D.Sc., A.I.C.T.A., Senior Plant Pathologist
7/38	No. 1078.	Mycological Notes: Seasonal Notes on Tobacco Diseases II. Two Destructive Curing Moulds, by J. C. F Hopkins, D.Sc. (Lond.), A.I C.T.A.. Senior Plant Pathologist.
8/38.	No. 1079.	Annual Report of the Branch of Plant Pathology for the year ending 31st December, 1937, by J. C. F. Hopkins, D.Sc. (Lond.), A.I.C.T.A., Senior Plant Pathologist.
8/38.	No. 1080.	Annual Report of the Division of Entomology for the year ended 31st December, 1937. by Rupert W. Jack, Chief Entomologist.
9/38	No. 1082.	The Life History of Root Gallworm or Root Knot Eelworm, by M. C. Mossop, M.Sc., Entomologist.
10/38.	No. 1086	The Spraying of Tobacco Seed-beds and Control of Rosette Disease, by J. C. F. Hopkins, D.Sc. (Lond.), A.I.C.T.A., Senior Plant Pathologist, and M. C. Mossop, M.Sc., Entomologist.
1/39.	No 1097.	Cleanliness Aids Insect Control: Some Examples of Agricultural Hygiene, by M. C. Mossop, M.Sc., Entomologist.
4/39.	No. 1108.	Three Important Strawberry Diseases, by J. C. F. Hopkins, D.Sc. (Lond.). A.I C.T.A , Senior Plant Pathologist.

POULTRY.

1/29.	No. 721.	Poultry Keeping in Rhodesia: Pedigree Breeding, by H. G. Wheeldon, Assistant Poultry Expert.
4/29.	No. 738.	Hints to Breeders: Rearing Young Stock, by A Little, Poultry Expert.
6/29.	No. 740.	Artificial Incubation, Breeding and Rearing of Chicks, by H. G. Wheeldon, Poultry Expert.
11/29.	No 761.	Housing and Feeding of Adult Stock, by H. G. Wheeldon, Poultry Expert.
10/30.	No. 795.	The Turkey, by G. H. Cooper, Assistant Poultry Officer
1/31.	No. 803.	Geese, by G. H. Cooper, Assistant Poultry Officer.
9/31.	No. 827.	The Ideal Brooder, by F. Roberts, Assistant Poultry Officer.

10/32. No. 865. Poultry Industry: Care of Young Stock in Hot Weather, by H. G. Wheeldon, Chief Poultry Officer.

11/32. No. 870. Trap Nests, by B. G. Gundry, A.I.MechE. (combined with No. 875).

12/32. No. 872. The Rearing and Fattening of Table Poultry, by H. G. Wheeldon, Chief Poultry Officer.

3/33. No. 884. The Vitamins in Poultry Feeding, by G. H. Cooper, Poultry Officer, Matopo School of Agriculture and Experiment Station.

5/34. No 918. The Moulting of Poultry: The Normal and Pullet Moult, by H. G. Wheeldon, Poultry Officer.

12/34. No. 939. The Use of Galvanised Iron in the Making of Some Appliances for Poultry Keeping, by G. H. Cooper, Assistant Poultry Officer, Matopo School of Agriculture and Experiment Station.

12/34. No. 940. A Cheap Portable Colony House for Poultry, by G. H. Cooper, Assistant Poultry Officer, Matopo School of Agriculture and Experiment Station.

3/34. No. 947. Modern Culling of Laying Hens, by G. H. Cooper, Assistant Poultry Officer, Matopo School of Agriculture and Experiment Station.

9/35. No. 966. Egg Marketing Bill: Draft of a Bill having for its purpose the more orderly Marketing of Eggs.

11/35. No. 971. Feeds for Poultry and How to Use Them, by G. H. Cooper, Assistant Poultry Officer.

The following pamphlets can be obtained from the Poultry Officer upon application:—

Selecting Birds for Laying Tests, by A. Little, Poultry Expert.

Tuberculosis, by A. Little, Poultry Expert.

Prevention of Disease among Poultry, by A. Little, Poultry Expert.

Preparing Birds for Show, by A. Little, Poultry Expert.

The Fowl Tick (Argas persicus), by A. Little, Poultry Expert.

Culling: A Seasonal Operation, by A. Little, Poultry Expert.

Choosing a Male Bird, by A. Little, Poultry Expert.

The Breeding Stock, by A. Little, Poultry Expert.

Diseases of the Digestive System, by A. Little, Poultry Expert.

Mating for Improvement and Increased Egg Production, by A. Little, Poultry Expert.

Partial Moult: Broodiness. Selection of Layers of Large Eggs, by A. Little, Poultry Expert.

Exhibiting Eggs at Shows, by A. Little, Poultry Expert.

Condition of Birds on Show, by A. Little, Poultry Expert.

Green Food: The Result of not Supplying Sufficient to Poultry, by A. Little, Poultry Expert.

Good and Bad Hatching Eggs, by A. Little, Poultry Expert.

Grading Fowls, by A. Little, Poultry Expert.

Housing: Three Important Essentials, by A. Little, Poultry Expert.

Advice to Prospective Poultry Farmers, by A. Little, Poultry Expert

Seasonal Hints—August, by A. Little, Poultry Expert.

Successful Chick Rearing, by H. G. Wheeldon, Assistant Poultry Expert.

Hints to Breeders, October, by A. Little, Poultry Expert.
Abnormalities in Eggs, by A. Little, Poultry Expert.
Hints to Breeders. Prepare for the Breeding Season, by A. Little.
Respiratory Diseases, by A. Little, Poultry Expert.
Selection and Preparation of Fowls for Exhibition, by H. G. Wheeldon, Poultry Expert.
The Close of the Hatching Season and After, by H. G. Wheeldon, Poultry Expert.

7/38. No. 1075. The Artificial Incubation, Brooding and Rearing of Chickens, by H. G. Wheeldon, Poultry Officer.
11/38. No. 1090. A Cheap Portable Colony House for Poultry, by G. H. Cooper, Assistant Poultry Officer.
12/38. No. 1092. Feeding and Drinking Appliances for Poultry, by G. H. Cooper, Assistant Poultry Officer.
5/39. No. 1111. Ducks on the Farm, by H. G. Wheeldon, Poultry Officer.

METEOROLOGICAL.

12/22. No. 436. The Possibility of Seasonal Forecasting and Prospects for Rainfall Season, 1922-23, by C. L. Robertson, B.Sc., A.M I.C.E.
12/24. No. 524. The Use of an Aneroid Barometer, by C. L. Robertson, B.Sc., A.M.I.C.E.
2/25. No. 532. The Short Period Forecast and Daily Weather Report, by C. L. Robertson, B.Sc., A.M.I.C.E.
6/25. No 542. Review of the Abnormal Rainfall Season, 1924-25, by C. L. Robertson, B.Sc., A.M.I.C.E.
10/28. No. 712. The Time, and How to Find It, by N. P. Sellick, M.C., B.Sc. (Eng.).
10/31. No. 832. The Weather Map and the Short Period Weather Forecast, issued by the Meteorological Office.
2/33 No. 877 Clouds and Weather in Southern Rhodesia, by N. P. Sellick, M.C., B.Sc., Meteorologist.
3/35. No. 948 The Weather, contributed by The Meteorological Office.

AGRICULTURAL BUILDINGS.

4/26. No. 588. Concrete on the Farm, by N. P. Sellick, M C., B.Sc. (Eng.), Assistant Irrigation Engineer.
8/26. No. 605. Flue-curing Tobacco Barns. Bulking and Grading Sheds, by P. H. Haviland, B.Sc. (Eng.), Acting Government Irrigation Engineer.
5/27. No. 644. Tobacco Baling Boxes, by B. G. Gundry, Irrigation Branch.
11/27. No. 661. Flue-curing Tobacco Barns, 12 ft. x 12 ft. x 16ft., by B. G. Gundry.
10/32. No. 863. Piggeries, by B. G. Gundry, A.I.Mech.E
5/33. No. 889. The Construction of Dipping Tanks, by B. G. Gundry, A.I.Mech.E.; and Notes on their Management, by J. M. Sinclair, M.R.C.V.S., Chief Veterinary Surgeon.
9/33. No. 902. Brick-making on the Farm, by A. C. Jennings, Assoc.M.Inst.C.E.
12/33. No. 908. A Charcoal Safe or Cooler, by B. G. Gundry, A.I.Mech.E., Irrigation Division.
5/34. No. 922. Dairy Building in Southern Rhodesia: A Small Farm Dairy, by B. G. Gundry, A.I.Mech.E.
7/34. No 926. Dairy Buildings in Southern Rhodesia. Cow Byre—Type II., by B. G. Gundry, A.I.Mech.E.
10/36. No. 1002. A Simple Farm Gate, contributed by the Division of Forestry.

5/37. No. 1031. Cattle Bale Grip.

8/37. No. 1041. Feeding Pens for Bullocks: the Layout at Estes Park, near Salisbury.

1/39. No. 1098. The "Gundry" Tobacco Furnace, by B. G. Gundry, A.I.Mech.E.

CHEMISTRY.

12/29. No. 762.—The Value of Rock Phosphate and "Bone and Superphosphate" as Fertilisers for Maize Production, by A. D. Husband, Chief Chemist.

4/32. No. 852. Mixing of Fertilisers: A Guide to Methods of Calculation, by the Division of Chemistry.

7/32. No. 858. The Softening of Waters, by the Division of Chemistry.

1/34. No. 910. The Toxicity to Grazing of Grass Sprayed with a Solution of Sodium Arsenite, by A. D. Husband, F.I.C., and J. F. Duguid, M.A., B.Sc.

9/34. No. 930. Analyses of Rhodesian Foodstuffs, by The Division of Chemistry.
Chemist.

5/35. No. 954. Experiments on the Toxicity to Fowls of Arsenite of Soda and Poisoned Locusts, by J. K. Chorley, F.R.E S., and R. McChlery, B.A., B.Sc.

4/36. No. 983. Annual Report of the Branch of Chemistry for year ending 31st December, 1935, by A. D Husband, F.I.C., Chief Chemist.

7/37. No. 1035. Analyses of Rhodesian Foodstuffs, by The Division of Chemistry.

MISCELLANEOUS.

4/28. No. 686. The Land Bank, Its Functions and How it Operates, by S. Thornton.

4/28. No. 687. The Use of Explosives on the Farm, by P. H. Haviland, B.Sc. (Eng.).

9/28. No. 707. Wood-Charcoal in Southern Rhodesia, by T. L. Wilkinson, B.Sc., Assistant Forest Officer.

5/31. No. 820. The Great Economic Problem in Agriculture—No. 1, by J. R McLoughlin, M.Sc. (Economist), Economic Adviser.

6/31. No. 823. The Law of Supply and Demand—No. 2, by J. R. McLoughlin, M.Sc. (Economics), Economic Adviser.
Twelve Simple Rules for the Avoidance of Malaria and Blackwater.
Summary of the Game Laws of Southern Rhodesia.

11/34. No. 935. The Weeds and Poisonous Plants of Southern Rhodesia, by Chas. K. Brain, M.A., D.Sc., Director of Agriculture. Part I.

8/35. No. 961. A Home-made Ridger. Contributed by Mr. Douglas Aylen, Somerset, Concession.

1/36. No. 975. Fertilizers, Farm Foods, Seeds and Pests Remedies Ordinance, 1914.

2/36. No. 979. The Prospects of Black Bass in the Inland Waters of Southern Rhodesia. Specially contributed.

6/36. No. 991. Silage and Silos.

8/36. No. 998. Summary of the Game Laws of Southern Rhodesia.

3/37. No. 1018. Veld Fires. The "Forest and Herbage Preservation Act, 1936," by E. J. Kelly Edwards, M.A., Dip. For. (Oxon.), Chief Forest Officer.

3/37. No. 1021. Breaking in Young Oxen to the Yoke, by J. B. West, Dromoland, P.B. Lonely Mine.

7/37. No. 1038. Star Bur-weed (*Acanthospermum australe*, O. Kuntze), by Chas. K. Brain, D.Sc., Director of Agriculture.

8/37. No. 1042. Weeds of Southern Rhodesia. Part II. By Chas. K. Brain, D.Sc., Director of Agriculture.

2/38. No. 1056. Notes on the Cashew Nut. By C. K. Brain, Director of Agriculture.

2/38. No. 1057. The Preservation of Farm Beacons and how to make use of the Fencing Law.

2/38. No. 1060. How to make Tobacco-Wash on the Farm, by M. C. Mossop, M.Sc., Entomologist, Department of Agriculture.

3/38. No. 1064. Farm Roads, by Stuart Chandler, Chief Road Engineer.

4/38. No. 1065. Nitrification in Red Soil in the Salisbury Area, by A. P. Taylor, M.A., B.Sc., and B. S. Ellis, B.Sc., A.I.C., D.I.C., Agricultural Chemists.

4/38. No. 1067. Grass Mowers, by H. Beynon, from "The Farmer," March 4th, 1938.

4/38. No. 1068. The Control of Veld Fires, by The Division of Forestry.

9/38. No. 1081. Uncontrolled Grass and Forest Fires and their Prevention, by the Rev. Father A. B. Burbridge, S.J.

11/38. No. 1088. How to Instal a Simple and Efficient Hot Water Supply on a Farm, by W. A. Welch, Tantallon Farm, Salisbury.

12/38 No. 1093. Cattle Bale or Grip.

1/39. No. 1096. Trees and Wild Flowers on the Rhodesian Farm. Part I. By Chas. K. Brain, M.A., D.Sc., Director of Agriculture.

2/39. No. 1099. Trees and Wild Flowers on the Rhodesian Farm. Part II. By Chas. K. Brain, M.A., D.Sc., Director of Agriculture.

3/39. No. 1102. Trees and Wild Flowers on the Rhodesian Farm. Part III. By Chas. K. Brain, M.A., D.Sc., Director of Agriculture.

4/39. No. 1106. Trees and Wild Flowers on the Rhodesian Farm. Part IV. By Chas. K. Brain, M.A., D.Sc., Director of Agriculture.

5/39. No. 1112. Trees and Wild Flowers on the Rhodesian Farm. Part V. By Chas. K. Brain, M.A., D.Sc., Director of Agriculture.

6/39. No. 1116. Trees and Wild Flowers on the Rhodesian Farm. Part VI. By Chas. K. Brain, M.A., D.Sc., Director of Agriculture.

7/39. No. 1119. Trees and Wild Flowers on the Rhodesian Farm. Part VII., by Chas. K. Brain, M.A., D.Sc., Director of Agriculture.

4/39. No. 1103. Scurvy and How to Prevent It. Public Health Pamphlet No. 3.

4/39. No. 1105. Fumigation with Hydrocyanic Acid Gas, by M. C. Mossop, M.Sc.

4/39. No. 1107. Some Notes on Game Bird Preservation, by W. E. Poles, Esq., on behalf of the Wild Life Protection Society of Southern Rhodesia.

6/39. No. 1114. The Rhodes Inyanga Estate.

7/39. No. 1118. Grass Fires and Fire-belt Burning, by J. R. Perrins, P.B.S. Ranch, Fort Rixon.

5/39. No. 1109. Summary of the Game Laws of Southern Rhodesia, as at 1st May, 1939.

NOTICE

The Agricultural Journal of S. Rhodesia

is issued by the Department of Agriculture, and can be obtained upon application to the Editor. The Annual Subscription, which must be paid in advance, is 5/-, and payment may be made by any means other than by stamps.

A 10/- note will cover the subscription for two years.

Persons residing outside Southern and Northern Rhodesia may become subscribers by paying 2/- in addition to the subscription, to cover postage.

If payment is made by a cheque drawn on a bank outside Rhodesia, commission must be added.

All cheques and postal notes must be made payable to the Secretary for Agriculture and Lands.

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*To the Secretary,**

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Editorial.

Contributions and correspondence regarding subjects affecting the farming industry of Southern Rhodesia are invited. All communications should be addressed to:—The Editor, Department of Agriculture, Salisbury. Correspondence regarding advertisements should be addressed:—The Art Printing Works, Ltd., Box 431, Salisbury.

Horsesickness Inoculation.—Vaccine for the inoculation of horses and mules of any age against horsesickness will be issued from now onwards until the end of November at a cost of 6/- per dose, post free.

Immunity does not reach its height until some months after inoculation, and owners are therefore urged not to defer inoculation until the end of the season.

The vaccine must be used within seven (7) days of its despatch from the Laboratory, and will be issued direct to applicants, who will be required to do or arrange for the inoculation themselves.

Directions for use will be supplied with the vaccine.

Applications, in writing, and enclosing the cash remittance, should be made to:

The Director of Veterinary Research,
P.O. Box 657,
Salisbury.

Orders will be dealt with strictly in rotation and according to the supplies which may be available at the time.

Applications will neither be acknowledged nor considered unless they are accompanied by cash (6/- per dose) and received by the 20th November.

HORSESICKNESS VACCINE.

Price: 6/- per dose.	Inoculate now.
Closing date for applications: 20th November.	Use within one week of its issue.

Tour of Matabeleland by Government Agriculturist.—Farmers are advised that the Assistant Agriculturist, Mr. S. D. Timson, will spend about one month in Matabeleland, as from the 14th September, for the purpose of giving advice on Field Husbandry matters to those farmers who require his services.

Farmers who wish to be visited by Mr. Timson are asked to submit their applications as early as possible to the Agriculturist, Department of Agriculture, Salisbury, and these should reach him by the 6th September. Thereafter similar requests may be addressed to Mr. Timson, c/o Irrigation Engineer, P.O. Box 566, Bulawayo, to reach that office not later than the 14th September, but no assurance can be given that requests for visits received after the 6th September will be complied with.

Burning of Fire Guards.—Referring to Major Perrins' article on the burning of Fire Guards, Mr. Dan Judson writes as follows:—"It contains much good advice, but there are some points upon which we disagree. My experience, extending over sixteen years, may be of interest. I do not like the

use of sacks as beaters. It is difficult to keep them suitably wet, and if at all dry they catch alight and become a positive danger. In any case, they tend to fan the flames. Dragging a bush or tree to form a strip I have found to be futile. At first I used gum tree branches as beaters and they were good, but dried too quickly and the task of replenishing was tedious. Since then I have grown cypress trees and the branches make perfect beaters, drying slowly and lasting for many hours without replacement. Nothing beats the mower for strip making. In other respects I agree with everything in Major Perrins' article."

A New Test for Pasteurised Milk.—It was found some years ago that all raw milk contained, as a normal constituent, an enzyme which, under appropriate conditions, could be readily recognised by its power to hydrolyse phosphoric esters. It was later found that this enzyme was destroyed almost completely by "legal" pasteurisation (145° F. for 30 minutes) so that its presence in, or absence from, milk might serve as a guide to the efficiency of pasteurisation.

The methods of testing milk for the presence of phosphatase were improved, and a delicate and reasonably simple procedure, usually called the "phosphatase test," was eventually worked out for detecting small traces of this enzyme in milk and related products. The test depends on the fact that sodium phenyl phosphate is one of the phosphoric esters most readily hydrolysed by the milk enzyme, to give free phenol, which is not a normal milk constituent, and uncombined phosphate. Any free phenol produced is made to react with Folin's well-known phenol re-agent, giving a blue compound which may be estimated colorimetrically. The delicacy of the test depends largely on using as criterion the liberation of a substance not originally present in milk. It is easier to test for the *appearance* of free phenol than for a *small increase* in the fairly large amount of free phosphate already present in the milk undergoing test.

The sensitivity of the test is such that 0.2 per cent. of the raw milk added to the pasteurised bulk may be regularly detected.

Spring Cleanliness.—The first generation of pests of stored products such as tobacco and maize normally appears in September and October, but should not be allowed to mature. Tobacco sheds should be cleaned or re-cleaned as early as possible. Now that the tobacco sales are over there should be no reason why Virginia tobacco sheds, etc., should not be properly clean, and there are commonsense and legal reasons why they should.

Concrete plans should now be made for the early and thorough disposal of maize shelling dumps in order to lessen field infestation by maize weevil. If dumps are to be burned, the material should be made to cover as much as practicable of the area covered by shelling operations. If they are to be utilised for making compost, the top soil used for the purpose should be taken from as much as possible of that portion of the area not actually occupied by compost heaps. If the area is to be fenced for cattle prior to making compost, the whole of it should be fenced. The above remarks suggest that future shelling operations be confined to as small an area as can be used. Talk it over with you farmer friends.

Clean and plough cotton lands. Use clean ground, clean water, and clean tools for tobacco seed-beds.

Pelicans in the Wankie Game Reserve.—Recently the Assistant Game Warden, whilst on patrol along the Nata and Sibanini Rivers, near the Bechuanaland Border in June last, made the following observations on the manner in which pelicans obtain fish:—

"The birds were first noted arriving in flights of fifty to a hundred, flying very high, from a westerly direction—probably the Makarikari Lake.

The method employed when fishing is as follows:—

About fifty birds make a line across the river and, all facing the same way, proceed to drive the fish to a corner of the pool. As the water narrows so the birds fall one behind the other in files until all the fish are in the desired corner.

They then start picking up the fish by ducking their heads and bringing them up again for air from time to time. While doing this, and about five deep, they move towards the bank. As the first rank reaches the bank they walk on to the shore. The next line of birds then leave the water and this continues until all are on land, when they move either by flying or by walking, to another part of the pool where a fresh drive is started."

Cleanliness Aids Insect Control.

Trees and Wild Flowers.
ON THE RHODESIAN FARM.

By CHAS. K. BRAIN, M.A., D.Sc., Director of Agriculture.

PART IX.

Schotia brachypetala Sond. Family *Leguminosae.*—This is a common tree usually found growing on the larger termite mounds in the granite areas. It may occur either as a shrub about four feet high or as a small tree usually 15 to 20 feet high. The leaves are deciduous, dark green with five or six pairs of rounded leaflets. The flowers are in dense bunches on the old wood and are deep crimson in colour (Fig. 57). It is in flower at the present time and is known to the natives as Mutondochuru, *i.e.*, the Mutondo or Mnondo of the termite mounds. In the Transvaal it is called "Boer Beans."

Dombeya rotundifolia Hochst. Family *Sterculiaceae.*—At this time of the year *Dombeya rotundifolia*, commonly called Wild Plum or Wild Pear because of the masses of white flowers, is one of the most conspicuous trees in the landscape. The trees are usually small but may reach a height of 25 feet. When growing near Kaffir-boom with its scarlet flowers the effect of the white and scarlet is most striking. The leaves usually appear after the flowers, but young leaves may be well developed by October, when the persistent flowers are turning pale pink and then brown. The fully developed leaves are roundish, about 3 inches in diameter. The flowers are in dense clusters and are sweet scented (Fig. 58).

The Frangipani. Family *Apocynaceae.*—The Frangipani is a Mexican tree with poinsonous milky juice. Two species are commonly grown, *Plumieria rubra* Linn. having golden flowers tipped with rose and *Plumieria acutifolia* Poir. with white flowers and yellow centres. They have become naturalised in the West Indies, where they are called jasmines. The white-flowered species is now grown in most tropical countries and is known by various names, including temple flower and graveyard flower (Fig. 59).

Fig. 57. Leaves, buds and pod of *Schotia brachypetala* Sond. Salisbury Commonage

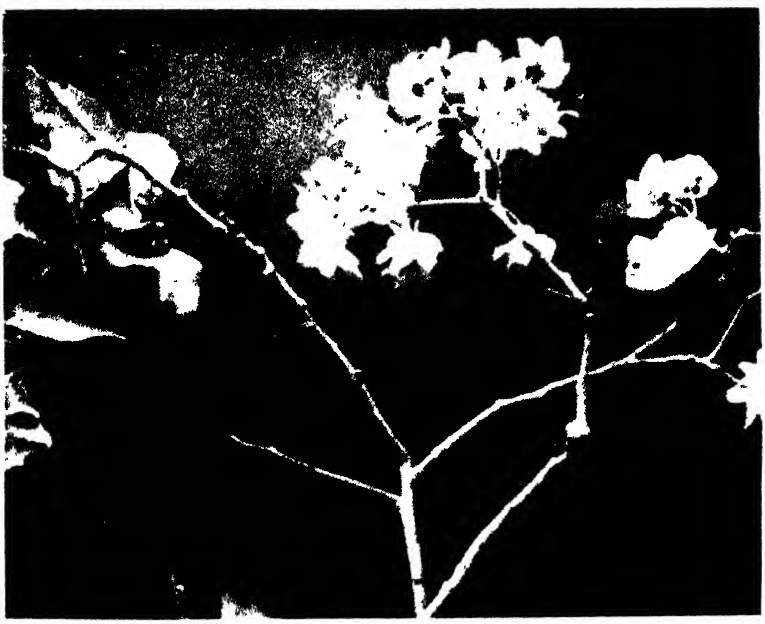


Fig. 58. Flowers and young leaves of *Dombeya rotundifolia* Hochst. Salisbury Commonage

Fig 59 *Frangipani*, common in Salisbury gardens.

Fig. 60. *Plectranthus floribundus* N E Br. Salisbury Commonage

Fig 61 Common Knot weed, *Polygonum aviculare* L. A common weed in wheat lands

Fig 62 *Polygonum tomentosum* Willd Cleveland Dam, Salisbury

Plectranthus floribundus N.E.Br. Family *Labiatae*.—This is one of the most striking shrubs of the sandveld which is in flower at the present time. It has long pale brown branches usually about 3 feet long and curved downwards, with numerous scattered racemes of bright yellow flowers on stems two to three inches long and no leaves at flowering time (Fig. 60). Children have given the name "scrambled eggs" to this plant. Its underground stems are thickened and are used by natives in times of famine as a substitute for sweet potatoes. Varieties of this plant are found throughout East Africa from Kenya to Natal.

The Knot-weeds or **Smart-weeds,** *Polygonum* spp. Family *Polygonaceae*.—Several species of knot-weeds or smart-weeds occur in Southern Rhodesia, but they are easily recognised by the membranous sheath which surrounds each knot or node where the branches join the main stems. These sheaths are sometimes short and finely divided, but in other species they are long and may have long hairs or not.

The Dooryard Knot-weed, *Polygonum aviculare* L., is an introduced weed from Europe. It is a semi-prostrate annual of a bluish green colour and the slender branches may reach 2 feet in length. The leaves are nearly elliptical, up to 1 inch long. The sheaths are silvery and split into narrow lobes. The flowers are very small, solitary or in groups of 2 or 3 in the axils of the leaves (Fig. 61). It is common in dry soil such as railway embankments, roadsides, etc.

The typical Smart-weeds are represented by several species which are commonly found in wet ground. The flowers are pink and are arranged in long cylindrical heads. *Polygonum tomentosum* Willd. (Fig. 62) is common on river banks where the thick red stems often reach a length of five or six feet. When the water is dammed up, however, the stems reach four or five times that length, and observations made at Cleveland Dam, Salisbury, would indicate that this weed is likely to become of great importance. It probably harbours snails and the decaying stems undoubtedly discolour the water.

Report of the Chief Animal Husbandry Officer.

FOR THE YEAR ENDING 31ST DECEMBER, 1938.

By A. E. ROMYN, Chief Animal Husbandry Officer.

Cattle Industry.—The general condition of cattle has been good during the past year and, despite the difficulties of water in Matabeleland during the dry season, the bulk of the cattle wintered well throughout the Colony.

A fairly widespread tendency to change over from dairying to beef in the case of marginal and casual cream producers has been evident. The primary cause for the change has been the higher prices for beef, but fear of the new dairying regulations and the discouragement of farm butter making have been contributary causes.

This change over is to the good in many instances, and farmers, while complaining of the loss of their cream cheque, have in most cases had to admit that their calves have never looked better. The sale of the improved calves, when mature, will probably more than compensate for the immediate loss of the cream or butter cheque. The veld, moreover, benefits from the lesser amount of kraaling and herding usual in beef production as compared with dairying.

The prosperity of the tobacco industry this year has caused the average tobacco farmer to neglect his cattle. Tobacco growers in general seem to have forgotten that in 1928-30 it was necessary to take to cattle to save themselves, and it is still just as unwise to concentrate on one crop.

Sunnhemp hay has come to the fore this year as a fee for cattle. The feeding results with this crop have so far been good, but further experience is needed on a large scale before its value in established feeding practices can definitely

be determined. A reduction in the price of molasses from the Rhodesian Sugar Refinery, Bulawayo, has popularised this feed in the Colony and all available supplies have been absorbed.

The "feeding of weaners" has definitely made a forward stride during the past winter, and it is encouraging to note that much more interest is now being shown in the efforts made by this Division to establish the sale of weaners on a commercial basis.

Noticeable areas of vlei lands are being laid down to improve vlei pastures to supplement the winter grazing. The early results are encouraging from a winter feeding standpoint, but the eventual success of the enterprise will depend on whether these vleis continue to hold their moisture after cultivation.

Export of Beef.—In May last the plant of the Rhodesia Export & Cold Storage Company in Bulawayo was taken over by the Cold Storage Commission of Southern Rhodesia in terms of Act No. 37 of 1937, without any break in the export of beef.

Prices for chilled beef in 1938 showed a considerable rise over 1937. A very satisfactory feature of this rise has been the narrowing of the price margin between the chilled beef exported from this Colony and that exported from other Empire sources. From September to November inclusive Rhodesian chilled beef (Imperial grade) sold at prices equal to or above chilled beef from all other Empire sources.

This particular rise is attributed to a rise in the average quality of the beef exported and to the stricter grading for age in the "Imperial Grade." For the first time in the last three years "Imperial Beef" has sold at a marked premium over Standard Beef. During the latter half of the year grading standards have been maintained on a consistent basis though there was some relaxation early in the year. It is essential, both from the standpoint of the producer and the market, to maintain consistent standards. This point cannot be too strongly stressed, as there is agitation each year to lower the grades during the scarce season.

The difficulty of finding supplies of suitable quality chillers from December to February or March, frequently alluded to in the past, still remains and, as the export of the lower quality beef might be developed to keep the works in operation over this period, a certain amount of below grade chilled beef was exported to the Provinces in the United Kingdom as an experiment. The beef sold at satisfactory prices in relation to its quality.

The guaranteed prices paid for chillers from June to December inclusive (the period of operation of the Cold Storage Commission) were as follows:—

1938.	Imperial Grade.	Standard "A" Grade.	Standard "B" Grade.
June	30/-	26/6	23/6
July	30/6	27/-	24/-
August	31/-	27/6	24/6
September	35/-	28/-	25/-
October	35/-	28/6	25/6
November	35/-	29/-	26/-
December	35/-	30/-	27/-

These prices were paid per 100 lbs. on the "net" dressed weight delivered at the Commission's works in Bulawayo. Cattle purchased out of hand were paid for on the above basis, less railage or cost of delivery, cost of purchasing and allowance for condemnations and rejects.

The prices on the local market and the net returns on the quota cattle sent to Johannesburg at times exceeded these prices. The Commission in consequence lost supplies of chillers which should not have been diverted from the works. Owing to the shortage of fat cattle to meet the three markets, attempts to raise the export price to secure supplies were only partially effective as, in the circumstances, they naturally resulted in a further rise in the local price.

On account of the comparatively high local price for compound and medium cattle there has been a large decrease in the amount of frozen and boneless beef exported this year.

The number of cattle slaughtered by Messrs. Liebigs for extract and canned beef, etc., showed, however, an increase over 1937.

Local Market.—The local market in the larger centres have been maintained at what is generally considered a satisfactory level throughout the year. Towards the end of the year the price of "compound cattle" was higher in proportion than the better grades of beef.

Pure Bred Cattle.—The breeders of pure bred cattle have had a good year and have disposed of their bulls at prices above last year.

Having in view, however, the vast need for good bulls to effect improvement in the herds of this Colony, and the Government assistance available towards the purchase of bulls, the demand has, on the whole, been disappointing. The limited local production of pure bred bulls has been practically equal to the effective demand, except in the case of some of the dual purpose dairy breeds, of which the supply is relatively much smaller.

A limited number of good bulls, chiefly of the dual purpose or dairy breeds, have been imported from the Union of South Africa. For the first time in several years a number of Swiss bulls have been imported and a good draft of beef Shorthorn bulls.

Breeders of pure bred cattle are, however, showing greater confidence in the industry than hitherto. In most cases they are expanding their breeding herds, though on a conservative basis. In the circumstances their policy is probably sound from the standpoint of the individual, though from a national standpoint a much faster expansion is desirable.

Livestock Improvement Scheme.—The following table shows the number of applications received and approved under the Livestock Improvement Scheme for the last four years:—

Year.	BULLS. No. of applications.		RAMS. No. of applications.		BOARS. No. of applications.	
	Received	Approved.	Received	Approved.	Received	Approved
1935	218	109	31	12	25	9
1936	241	175	90	71	18	5
1937	200	148	63	57	13	8
1938	247	175	56	42	19	12
Totals	906	607	240	182	75	34

The number of applications show a small increase on the previous year.

The grants actually paid out on bulls during the current year up to date have been:—

Aberdeen Angus	41 bulls and 15 heifers.
Hereford......	34 bulls.
Friesland	15 bulls.
Africander	28 bulls.
Red Poll	7 bulls.
Shorthorn	15 bulls.
Sussex	28 bulls.
Guernsey......	1 bull and 5 heifers.
North Devon	2 bulls.
South Devon	2 bulls.
Ayrshire......	1 bull.
Brown Swiss	2 bulls.

The scheme has now reached a stage when it should be amended. The remarks made under this heading in my report of 1937 still apply.

The present scheme is not reaching a sufficiently wide circle of farmers. It has done a great deal of good, but there is now the tendency for it to be used chiefly by a too limited group of established cattle farmers, many of whom come back year after year for grants.

The good prices ruling for all classes of slaughter cattle at the moment have apparently removed the incentive to improve in many cases and it appears that no great progress

will be made in the genetic quality of the general herds unless some method of compulsion is adopted to cut out the undesirable bull. A "bull licencing scheme" was considered this year by the Rhodesia Agricultural Union at their annual meeting, and it would seem advisable to substitute a scheme of this type for the present system.

Grading of Beef for Local Consumption.—The grading of beef for local consumption in Bulawayo has lost ground this year.

Most of the butchers have not been in favour of the scheme and the general public, in the absence of any vigorous advertising scheme, has proved apathetic.

The scheme has been further handicapped by the comparatively high price of cattle suitable for grading as "choice beef." High prices usually cause the local butcher to limit his purchases as far as possible to cheaper cattle of poorer quality.

The local market is not likely to be a satisfactory outlet to the European producer until beef is paid for and sold on some basis which bears a more definite relationship to its quality and cost of production than the present one. This ideal will not be attained until there is a compulsory system of grading beef at the larger centres in the Colony.

At present an unsound position exists in that the producer of the better quality of cattle has to rely chiefly on a subsidised market overseas for the sale of his beef, while the local consumer is actually discouraged from eating meat by the poor quality of much of what he is sold.

In view of the poor support of the voluntary scheme it may be advisable to discontinue the local grading service for beef in Bulawayo next year.

Pig Industry.—The passage of the Pig Industry Act, 1937, has changed the outlook of the pig industry in this Colony.

Bacon pigs are now graded after slaughter and minimum prices have been fixed for the various grades. Provision exists to extend these provisions to pork for local consumption.

The "minimum" prices which have been in operation during the year 1938 for bacon pigs are:—

A Grade—$4\frac{5}{8}$d. per lb. liveweight.

B Grade—$4\frac{1}{8}$d. per lb. liveweight.

C Grade—$3\frac{3}{4}$d. per lb. liveweight.

No price is fixed for pigs which do not fall within these grades.

Deduction of $\frac{1}{8}$d. per lb. liveweight may be made from these prices for pigs showing deficient bellies, seedy cut or deficient hams.

There has been a shortage of both bacon and pork pigs throughout the year and the bacon factories have, on their own initiative, since April last, in most cases been paying $\frac{1}{4}$d. to $\frac{3}{8}$d. per lb. liveweight more for each grade. Pork pigs have realised up to 7d. per lb. dressed weight, though 5d. per lb. dressed weight is a more representative price.

Pig production this year has not shown the expansion which was anticipated with the stimulus of fixed prices. Pig producers have still in mind periods of low prices in the past, and as prices for cattle and maize have been good affording alternative outlets for their efforts, they have not yet shown a tendency to "get back into pigs" wholeheartedly. A great deal of foundation work has been done, however, the effects of which should be apparent in 1939. Efficient producers have increased their breeding herds, though an unfavourable winter has held up progress in the Melsetter and Chipinga areas.

The grading system has been successful. Producers have now generally accustomed themselves to the system, though it was at first treated with suspicion. A definite improvement in the quality of the pigs arriving at the factories is evident. The chief improvement was effected within the first few months and since then supplies have somewhat stabilised themselves at the higher general level of quality reached at the end of the first three to four months.

The increased interest in pigs was especially reflected at the Umtali and Bulawayo Shows, where in quality and numbers the pig exhibits far exceeded anything seen at those centres in the last five or six years.

A number of pig producers who are not dairy farmers have increased their breeding herds this year. These producers rely largely on meat or bloodmeal as a protein supplement to balance their farm rations. The local supply of these two feeds has been short this year, and there may be a much more serious shortage next year if the anticipated expansion in pig production takes place. It may, therefore, be necessary to make arrangements to import these feds in bulk.

Sheep Industry.—Assisted by a dry winter, 1938 has been the best sheep year in the Colony for a decade. Lambing generally has been good and the prices realised for Eastern Border wool clips have been satisfactory considering the state of the market. The price of mutton has been satisfactory, but local supplies still cannot meet the demand and are mostly of inferior quality.

More interest generally is being shown in the health of the sheep and dosing can now be said to be established. The improved condition of the sheep, due in part to the dry winter, has resulted recently, however, in a slackening in the routine of dosing. This set-back is likely to be only a temporary one, as the condition of the undosed sheep during the coming rainy season will bring home the necessity for regular treatment throughout the year again.

A number of breeding sheep have been imported from the Union this year. Several experienced sheep farmers from the South have also taken up farms in the Colony. These importations should help materially to advance the industry.

An Animal Husbandry Officer to devote his main time to sheep was appointed during the year. He has been stationed at Melsetter.

Experimental Work.—The chief work of this Division in the past year has been the development of the Grasslands Experiment Station at Marandellas. The ground has been prepared here for a general study of the problem of the amount

of beef which can be produced per acre on sandveld under "typical Mashonaland" conditions and the effect of various systems of management on the natural veld. The general direction of this work is under a Pasture Research Committee, but the administration and management of the Station and the experiments are carried out by this Division.

Publications.—In co-operation with the Government Experimental Farm at Bulawayo, the following work has been published this year:—

(1) Feeding of Sunnhemp Hay as compared with Cowpea Hay in a fattening ration for bullocks.—*Rhodesia Agricultural Journal*, January, 1938.

(2) Protein Supplements for fattening cattle. A comparison of Meat Meal, Groundnut Cake and Cotton Seed.—*Rhodesia Agricultural Journal*, March, 1938.

(3) Cost of Fattening Bullocks of various ages in Matabeleland. — *Rhodesia Agricultural Journal*, November, 1938.

Bugs and beetles take their toll
but
Cleanliness Aids Insect Control.

The Course of Prices of Certain Agricultural Products in Salisbury.

By the Acting Government Statistician.

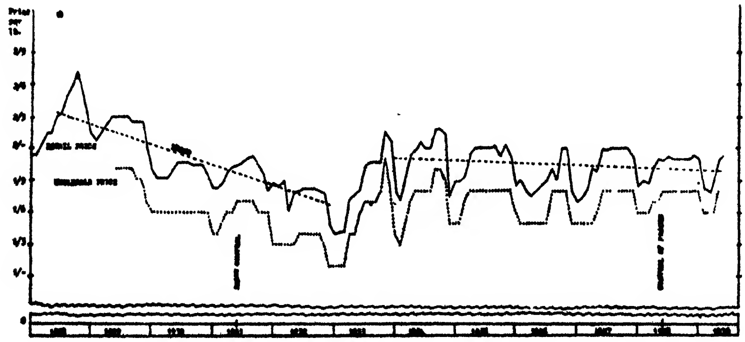
Certain statements have been made in the Press and elsewhere to the effect that legislation introduced for the orderly marketing of the agricultural products of the Colony has resulted in raising the prices to consumers. At the request of the Department of Agriculture an investigation into the course of prices of certain agricultural products over a number of years has been carried out and the results are published in this article with the object of placing on record a clear picture of what the fluctuations in price have actually been.

The prices of the ten commodities enumerated below have been analysed and graphs drawn by means of which the fluctuations which have occurred from year to year can be seen at a glance.

(1) Butter.	(6) Sirloin of Beef.
(2) Cheese.	(7) Potatoes.
(3) Bacon.	(8) Flour.
(4) Eggs.	(9) Maize Meal.
(5) Milk.	(10) Maize.

With the exception of maize the prices utilised are those quoted by six or seven of the leading grocers, produce merchants or butchers in Salisbury and represent the average retail prices paid by consumers in Salisbury throughout the period.

The period during which orderly marketing has been in force is indicated on the graphs of prices of those commodities for which Government control measures have been instituted.



No. 1.

(1) Average monthly retail and wholesale prices of First Grade Butter per lb. Salisbury, 1928-1939.

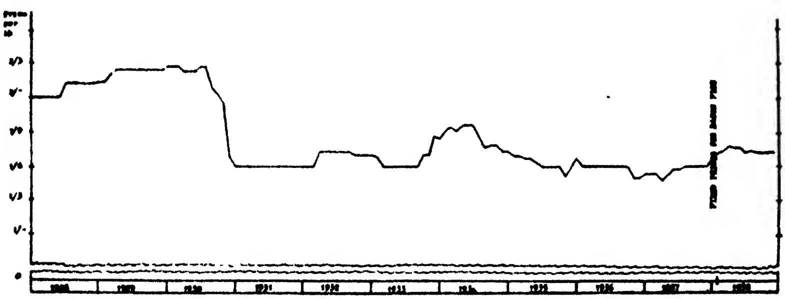
(1) **Butter—First Grade 1928-1939.**—A study of the graph showing the monthly retail prices of first grade butter as quoted by grocers in Salisbury shows that there have been two distinct phases of retail prices during the last eleven years, the first being from 1928 to the end of 1932 and the second from 1934 to 1939. The first phase showed a sharp fall in the trend of prices. The year 1933 was one of rising prices to a level about midway in the first phase. From this point the second phase commenced during which the trend was very slightly downwards.

The graph also shows the fluctuations in the wholesale price of butter so far as they are available throughout the period.

No. 2

(2) Average monthly retail prices of First Grade Local Cheddar Cheese per lb. Salisbury, 1928-1939.

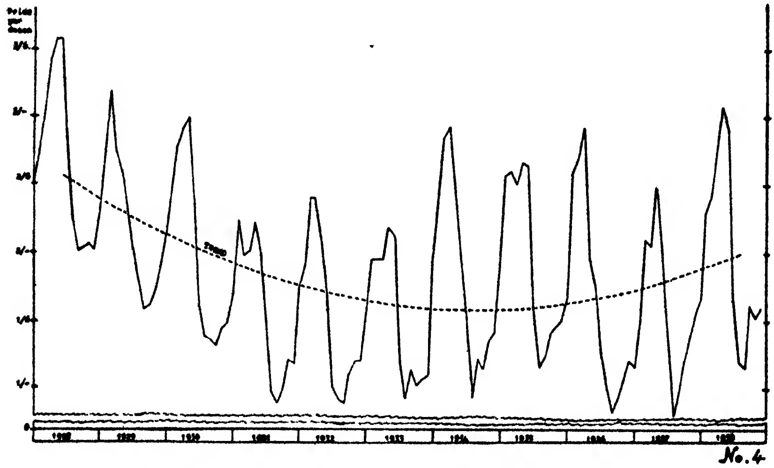
(2) **Cheese—First Grade Local Cheddar.**—The prices are those quoted by Salisbury grocers for first grade local Cheddar cheese per lb. During 1928 the price of cheese fluctuated between 1/11 and 1/10 per lb. In 1929 the price was around 1/11 dropping in 1930 to 1/9. During 1931 the price fell to 1/7 and in 1932 to 1/6. At the end of 1933 there was a sharp rise to 1/10, followed by a drop to 1/6½ in the early part of 1934. Thereafter the price wavered around 1/8 until the last quarter of 1935, when it began to fall again, remaining around 1/4 during most of 1936 and until half way through 1937, when it rose sharply to 1/6 and has been maintained within one penny of that price throughout 1938 and 1939.



N.3

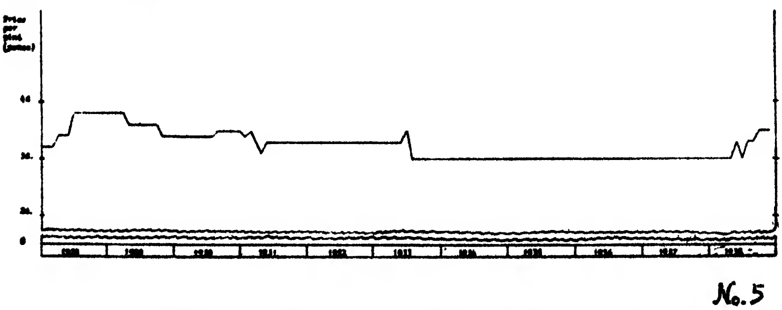
(3) Average monthly retail prices of Bacon (backs and streaky) per lb. Salisbury, 1928-1938.

(3) **Bacon—Back and Streaky.**—The graph showing the monthly retail prices of bacon (back and streaky) in Salisbury indicates that until August, 1930, prices moved upwards from 2/- to about 2/2½, after which date there was a rapid fall to 1/6 at the beginning of 1931. The price remained at this level throughout 1931 and the first quarter of 1932. During the rest of the year 1932 prices remained between 1/7½ and 1/7. In 1933 prices varied between 1/6 and 1/8½. During 1934 prices ranged between just over 1/9½ and 1/7¼, and in 1935 there was a further drop of about one penny per lb. to 1/6, which price was maintained until October, 1936, when the price fell to 1/5 until the end of the year. The year 1937 saw a slight rise to 1/6 and 1938 prices ranged between just over 1/6½ and just under 1/8, remaining fairly steady at about 1/7¼ for the last few months of the year.



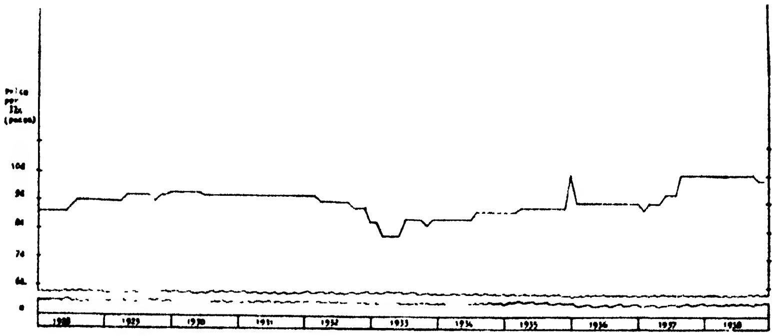
(4) Average monthly retail prices of Eggs per dozen.
Salisbury, 1928-1938.

(4) **Eggs.**—Owing to the large seasonal fluctuations in the retail price of eggs per dozen in Salisbury during 1928-38 it has been found necessary to fit to the graph a line of trend. This shows that from 1928 until 1934 prices moved downwards, the maximum and minimum prices during this period being 3/7 a dozen in May and June, 1928, and 10¾d. in September, 1931. From 1934 onwards the trend has been upwards, maximum and minimum prices during the latter period being 3/1 in May, 1938, and 9½d. in August, 1937.



(5) Average monthly retail prices of Milk per pint.
Salisbury, 1928-1938.

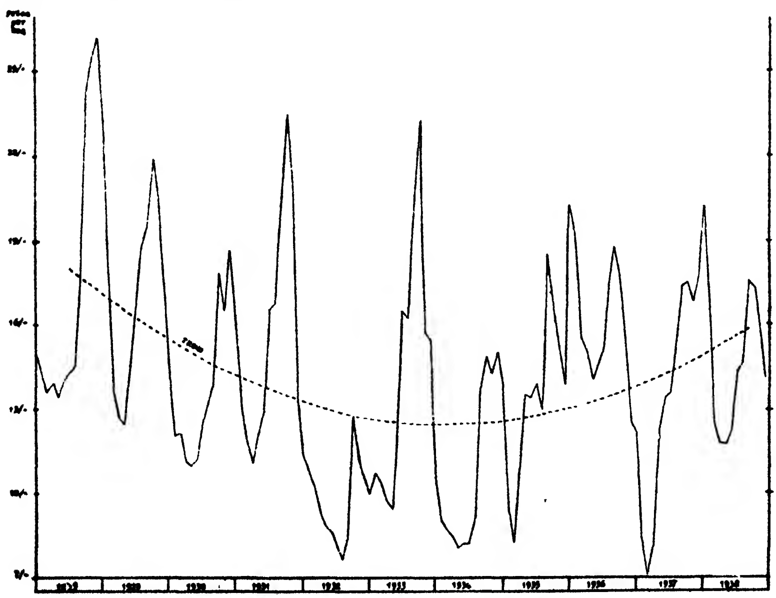
(5) **Milk.**—Not much need be said about the retail price of milk, which has varied between the maximum price of 3.8d. per pint during 1928 and 1929 and 3d. during 1933 to 1938. During the latter part of 1938 the price rose to 3½d.



No 6

(6) Average monthly retail prices of Sirloin of Beef per lb. Salisbury, 1928-1938.

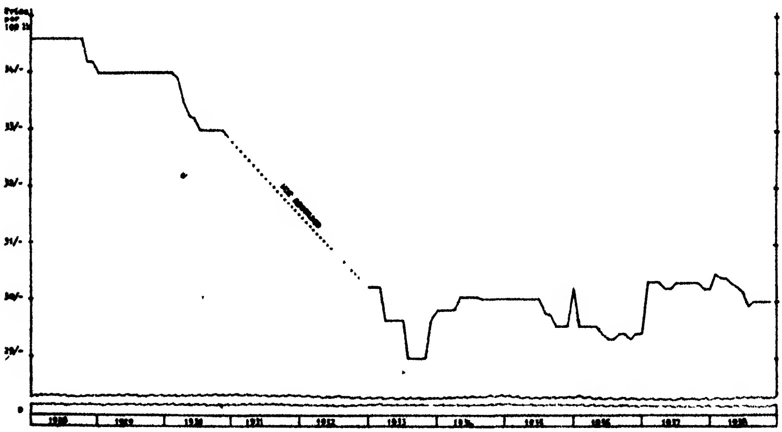
(6) **Sirloin of Beef.**—Throughout the period 1928 to 1938 the maximum fluctuation in the retail price of sirloin of beef per lb. in Salisbury has been 2 1-5d. The lowest price recorded was 7.8d. from March to June, 1933, since which time there has been a rise to 10d. per lb., which lasted from September, 1937, to October, 1938, after which there was a very slight decrease.



No. 7

(7) Average monthly retail prices of Potatoes per 150 lb. bag. Salisbury, 1928-1938.

(7) **Potatoes.**—The retail price of potatoes per 150 lb. bag in Salisbury has shown such large seasonal fluctuations that it has been necessary to fit to the graph a line of trend. This shows that the trend of prices fell fairly rapidly from 1928 until 1933, after which date there was an upward movement, which was being maintained in 1938. The maximum and minimum prices were 26/2 in December, 1928, and 7/2 in March, 1937. It will be seen that the price movement is a seasonal one with high and low prices occurring fairly regularly during certain months of the year. There has been a very noticeable variation in the difference between the highest and lowest prices in certain years. For instance, in 1933 prices rose from 9/6 in May to 23/2½ in October—a difference of 13/8½, while in 1936 the highest price was just under 20/3 in January and the lowest 12/7 in December—a difference of 7/8. During 1932 the highest price was just under 12/9¾ in October and the lowest price 7/7¾ in August —a difference of only 5/2.

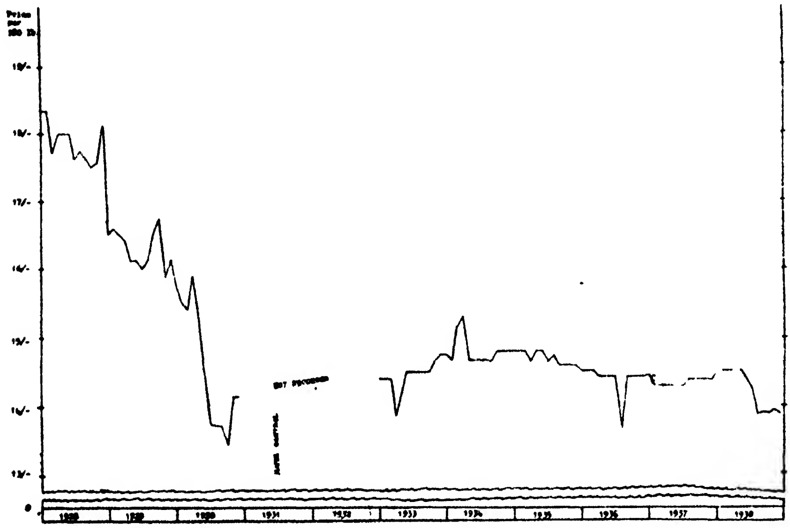


No. 8

(8) Average monthly retail prices of Local Flour per 100 lb. Salisbury, 1928-1938.

(8) **Flour—Local.**—The graph of retail prices of local flour per 100 lbs. in Salisbury during the period 1928-38 is, unfor-fortunately, not complete, as during 1931 and 1932 these prices were not recorded. The graph shows, however, that prices fell rapidly from 34/7 during 1928 to 29/- from August to November, 1933. A recovery followed bringing the price

to 30/1 from May, 1934, until July, 1935, after which there was another drop with minor fluctuations to 29/4 in August, 1936. In February, 1937, the price rose again to 30/4 and fluctuated about that price until in September, 1938, it was exactly 30/-, at which level the price remained steady until the end of the year.

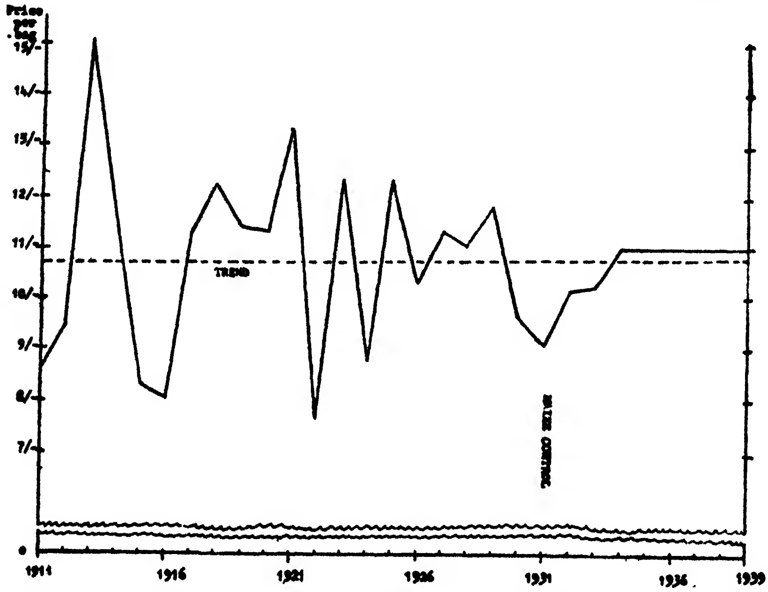


No. 9

(9) Average monthly retail prices of Maize Meal (first grade) per 180 lb. bag. Salisbury, 1928-1938.

(9) **Maize Meal.**—The graph showing retail prices of maize meal per 180 lb. bag in Salisbury during 1928-1938 is again not complete, as during 1931 and 1932 the prices were not recorded. This break, however, does not prevent the following conclusions being drawn.

There was a very rapid fall in price from January, 1928, when the price was 18/4 to October, 1930, when the price was 13/5, but since 1933 prices have with one or two fluctuations tended to remain steady around 14/6, although in the latter half of 1938 there was a fall until by December of that year maize meal was being retailed at just under 13/11 per bag.



(10) Annual average wholesale price of Maize per 200 lb. bag. Salisbury, 1911-1939.

No. 10

(10) **Maize—Wholesale Price per 200 lb. Bag.**—In order to show the fluctuations in wholesale price of maize in Salisbury during the period 1911-39 the method adopted has been to utilise figures quoted by the Salisbury Farmers' Co-op. Ltd. from 1911 to 1930 and by the Maize Control Board since 1931. The prices plotted for the period 1911-30 are the Farmers' Co-op. pay-outs plus 4d. per bag, representing the annual average cost of maize to the consumers in Salisbury and for the period 1931-39 the prices shown are the Maize Control Board prices for 15 ton lots and over f.o.r. Salisbury.

The following conclusions can be drawn from the graph and trend line.

(1) The annual average wholesale price of maize in Southern Rhodesia from 1911 to 1939 was 10/9 per bag.

(2) Over this period there has been only a very slight rise in the trend of prices.

(3) There has been a marked diminution in the magnitude of the fluctuations in price during the period, the fluctuations disappearing in 1934, since when the price has remained fixed at 11/- a bag or 3d. per bag above the average for 29 years.

Fig. 48 Poor farming methods contributed to the failure of these soil conservation works in Georgia, U.S.A. (Photo by courtesy of the Soil Conservation Service)

Soil and Water Conservation

PART III. (*Continued.*)

SOIL CONSERVATION AND FARMING.

CHAPTER VIII.—PLOUGHING.

By D. Aylen and the Irrigation Officers.

Humus and Good Ploughing.—Two of the most vital factors in erosion control are high humus content and good ploughing. Erosion proceeds far more rapidly on impoverished land which has been poorly ploughed, and such a land may require twice as many ridges as one in good heart. It also appears that land originally deep and highly fertile erodes very rapidly when depleted of humus.

Ploughing of Contour-ridged Land.—Ploughing should always be done on the contour, except on almost flat lands where it is permissible occasionaly to plough across the ridges if they are made wide enough.

The extra time taken to plough a contour-ridged land is very small, except on steep slopes and acute curves, and in such cases the obsence of gullies often more than compensates for the inconvenience, apart from the fact that without ridges there might be no land to plough. Moreover, with contour ploughing there is no heavy uphill pull.

On steep lands a difficulty arises from the fact that the ridges are seldom parallel, and wedge-shaped pieces of land are left unploughed. Excessive turning and trampling on the land can be avoided by ploughing these pieces separately with a single-furrow or reversible plough, or trampling can be avoided by ploughing the wedges first.

Another difficulty that arises sooner or later is when, through the ploughs always being entered in the same furrow, the finishing and opening furrows eventually become hollows and banks. When once the ridges have been sufficiently widened by ploughing against them it is advisable to change the system of striking out. Even before this time it may be as well to alter the position of the central "blind" or finishing furrow. This can be done by ploughing the land between the ridges in two strips instead of one, and perhaps altering the widths of the two strips from year to year.

The illustration shows a system of ploughing which will not only achieve this object but will also perform the maintenance of the ridge (on flat lands) and trough.

The plough is entered on the ridge with the front wheel on the crest (A) and ploughs the side slopes, throwing the soil inwards. This covers "strip No. 1," which, needless to say, must be omitted on narrow ridges and on steep lands.

Strip No. 2 is next ploughed, striking out the opening furrow at B at an even distance from the ridge. This distance should be altered every year. Ploughing by back-furrowing (throwing inwards) is continued until it reaches strip No. 1 thereby widening and deepening the trough.

An alternative method is to utilise two or three outward strips in reploughing the upper slope of the bank and so still further raising it.

Strips Nos. 1 and 2, it will be noted, are ploughed with a right-hand turn, and to avoid overturning the plough a "figure of eight" turn should be made.

Strip No. 3 is then ploughed in the ordinary way. The position of the finishing furrow F varies owing to the yearly alteration of the width of strip No. 2.

This system of ploughing may be alternated with other methods, as thought advisable. For instance, the plough may be entered in the old finishing furrow and the whole land back-furrowed, thereby filling the central hollow and pushing the soil *away* from the ridges, or the centre portion may be back-furrowed and the two remaining small pieces ploughed as one "furrow," and in a similar manner.

Fig 49 The start of gully erosion on red loam soil

Fig 50. The start of gully erosion on sand veld.

Fig 51 Shallow soil is soon removed by erosion exposing sterile sub soil

Fig. 52. Gullies on which deep soil rapidly extend up the slope by head erosion.

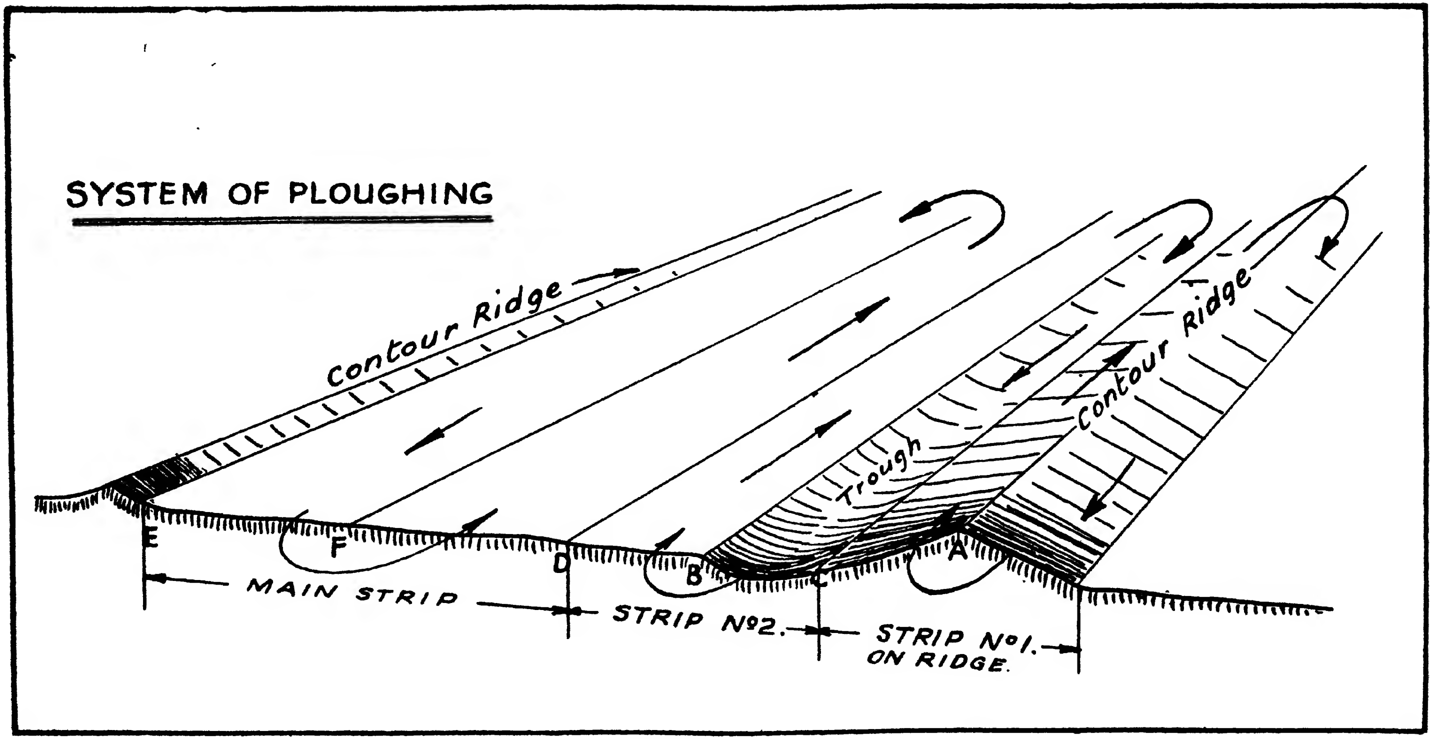

SYSTEM OF PLOUGHING
Contour Ridge
Contour Ridge
Trough
A
B
C
D
E
F
MAIN STRIP
STRIP No2.
STRIP No1.
ON RIDGE.

Fig. 53

If the land has been ploughed in two strips, the two finishing furrows may be closed by ploughing them at the same time, the forward trip along one and the return trip along the other, and thus throwing in one direction only, which almost closes them and avoids undue turning and trampling.

On shallow soil or tobacco lands it is most important to keep the depth of the soil the same throughout the strip between the ridges. The formation of a shallow patch in the centre can be overcome by variations of the methods outlined above.

If reversible ploughs are used the soil should be thrown uphill quite as often, if not more often, than it is thrown downhill.

Once the ridge and trough have been made adequate, they should not be increased in size but only maintained by the various methods when necessary. An unduly large bank is a waste of good soil, though this is far from a common fault.

No hard-and-fast rule can be laid down. Each farmer must use his own discretion as best suits his farming practice, implements and needs.

Ploughing "Headlands."—The turning of ploughs in the land without lifting them produces a hollow just inside the land and a bank at the edge. The hollow is often a serious cause of erosion. In such a case it is good practice to plough the headland up and down the slope, but in such a way as to work the bank into the hollow and completely fill it. The only hollow left is the small finishing furrow which is in the hard ground outside the land, which should be made with the plough set very shallow indeed. The most useful ploughs for the purpose are single-furrow and reversible ploughs. Alternatively an ordinary plough may be taken right round the edge of the land.

In this case the plough is entered in the hollow and follows along it on all four sides of the land. The direction of ploughing is such that the furrow is thrown away from the edges of the land. Ploughing is continued until the strips between the hollows and the veld is completed.

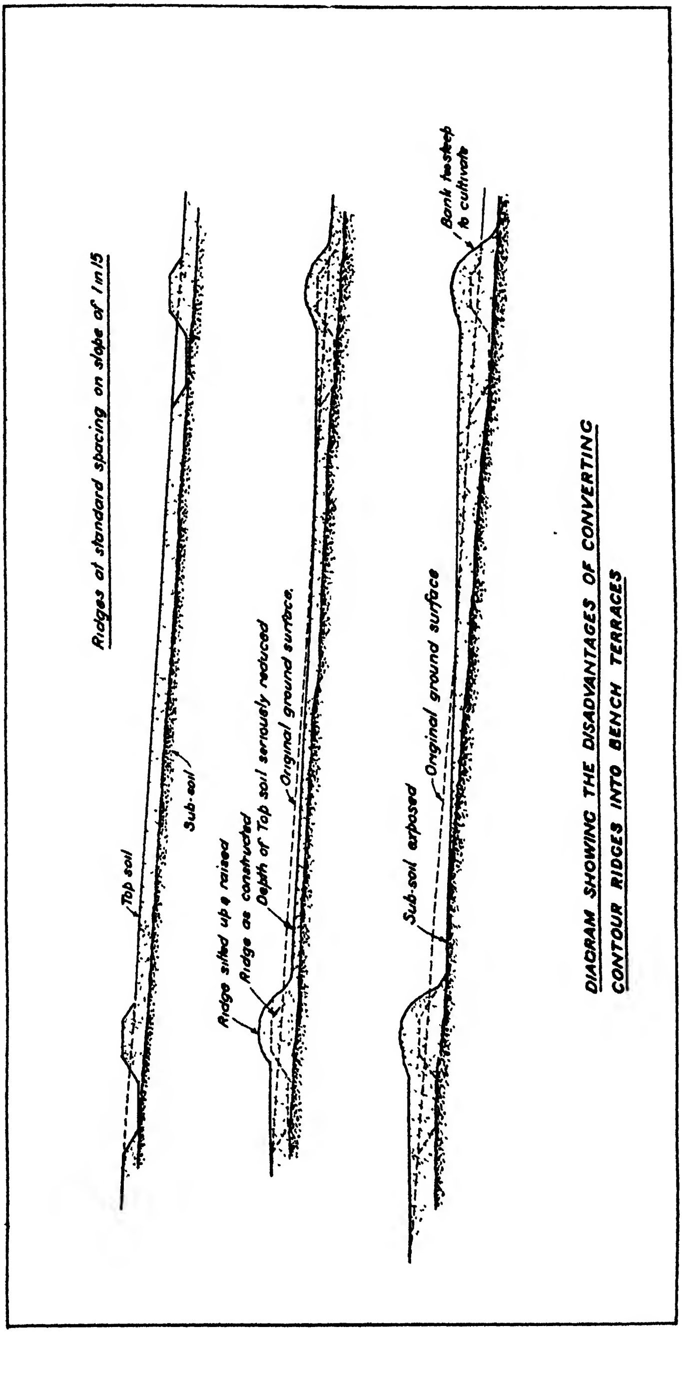


DIAGRAM SHOWING THE DISADVANTAGES OF CONVERTING CONTOUR RIDGES INTO BENCH TERRACES

Fig. 54

In extreme cases of large hollows and high banks the process may have to be repeated several times. A land leveller can be used with advantage, and as soon as all loosened soil has been moved the ground should be reploughed. The dangerous bank and hollow can be entirely eliminated by this means.

As far as possible the formation of a hollow at the headland should be avoided by continuing the straight furrow into the veld, and turning to enter the new furrow with the plough lifted right out. In preference to ploughing round the headlands, where there is not enough room to turn outside, they should be ploughed as a separate strip, throwing in opposite directions each year.

Dangers and Difficulties of Terracing Effect.—A far more serious problem is the gradual conversion of ridges into level terraces by the exclusive use of reversible ploughs throwing downwards, which denudes the upper part of the land and piles the soil against the ridge. It would be physically impossible to even out the soil once this had happened. An even depth of soil can be maintained by back-furrowing in alternate years with an ordinary plough, and throwing uphill as often as possible with the reversible plough. The latter has many uses in farming contour ridged land, but should not be used throwing downhill exclusively.

The object of contour ridges is to grow good crops all over the protected area. Owing to the considerable drop between ridges, unless specially close spaced for that purpose, the formation of a terrace can only be brought about by removing a considerable depth of top soil from the upper part of the strip to pile it on the lower. True bench terraces are purposely so narrowly spaced that even after levelling out the terrace there is still sufficient good soil left at the upper edge. Bench terraces designed for irrigation are made quite short and with different gradients to those used for contour ridges.

The disadvantages of attempting to convert standard spaced contour ridges to bench terraces are many.

(1) The removal of top soil from the upper half.

Fig 55 Erosion on a contour ridged land due to poor farming methods

Fig 56 A contour ridge converted into a terrace bank due to improper farming methods.

(2) Eventually exposes sub-soil which overlays all the strip.

(3) The best soil is now mainly buried in the huge bank.

(4) This bank is difficult to maintain and must be kept under a cover of grass, and cannot be crossed by any machinery. Cattle walking down it do great damage. Rats can also easily damage it.

(5) In the event of a break head erosion is rapid owing to the high overfall and a large hole is formed which is most difficult to repair.

(6) On heavy soils bench terraces might cause the retention of excessive amounts of water during a long wet spell.

Important.—In all cases where contour ridges are terracing it is most urgent that the proper steps be taken immediately to correct this evil, either by

(1) Intermediate ridges to effect better control.

(2) Better farming methods.

(3) Change over of reversible ploughing from downhill to uphill.

(4) Conversion of the system to correct spacings, gradients and lengths of a design suitable for that purpose.

CHAPTER IX.—STRIP CROPPING.

Except on very gentle slopes (flatter than 1 in 100) strip cropping can only be considered a temporary or emergency measure. The advantages of the greater protection afforded by contour ridges and their permanency completely outweigh the slightly higher initial cost which in any case is almost insignificant compared to the benefits which accrue.

In certain cases where soil is highly erosive modified forms of strip cropping can be most advantageously used in conjunction with contour ridges.

Recommendations for the use of strip cropping are therefore limited to—

(1) Cases where a new occupier of a farm wishes to afford some protection to lands that cannot be contour-ridged that season.

(2) Cases where, owing to highly erosive soil, contour ridges alone are not satisfactory, and further protective measures are required.

(3) Gentle slopes where owing to light rainfall or very absorbtive soil big run-offs do not occur. Strip cropping, contour planting and listing may then almost prevent all run-off.

The object of strip cropping is to check the rush of surface water. Filter out the silt which it carries and increase the absorption of water, not only in the close growing strip but elsewhere also, as clean water penetrates better than muddy water.

The run-off and erosion on a land carrying such clean cultivated crops as (*a*) maize, cotton, tobacco and sunflowers are much greater than for low-growing, running, or dense crops such as (*b*) Rhodes grass, thick-sown sunnhemp, wintersome, Dolichos bifloris, rapoko, native beans, cereals, lucerne, etc. By alternating strips, on the contour, of (*b*) crops with (*a*) crops, serious erosion is checked and penetration of water increased.

Various Methods of Strip Cropping.

(1) *Strip Interplanting or "Buffer" Strips.*—After contour-ridging a badly-eroded, badly-farmed land, and to prevent excessive soil movement during the years that the land is being re-conditioned, strips of (*b*) crops can be planted at intervals of about twenty rows. At every gully a small brush-wood and straw check should be made, and semi-permanent (*b*) crops or grass should be planted in the silt. This method will give the quickest results in smoothing a badly-gullied land.

(2) Strip-planting the line of a contour-ridge is useful when for any reason it is not possible to build the ridge at once. The strip should be 5 to 7 yards wide, and all gullies should be blocked as under (1) above.

(3) Strip-farming consists of wider strips of alternating (*a*) and (*b*) crops, planted on the contour, but is not generally intended for permanent protection, and should be replaced by contour ridges as soon as possible.

(4) Permanent systems of strip-cropping between wide-spaced contour ridges on steep slopes can be practised by modifications of the three methods above. For instance, hay crops and tobacco could be alternated, the hay being planted on the upper half of one strip and tobacco on the lower half, and the opposite arrangement for the next strip below the contour ridge.

(5) *"Filling" Strips.*—This is a useful way of evening the distance between irregular contour ridges. The main crop is planted just below and along a ridge, and the rows are continued half way down the strip. A strip-crop is then planted, and if a grass, can be used as a roadway for reaping tobacco, etc. The main crop is then continued in parallel rows almost down to the next contour ridge, when the remaining area is planted to a (*b*) crop, thus holding up silt and avoiding short rows. This strip-crop can be a permanent one.

(6) Permanent hedges in the veld should be planted on the contour, and may consist of good covering grasses or rows of aloes, briar roses, Napier grass, Vi-Vi, small trees and shrubs, etc. The subject is further described in Departmental Bulletin No. 1,016, "Natural Protection from Soil Erosion."

(7) *On New Lands.*—It is often impossible to contour-ridge a land the same year that it is cleared, and there is a common idea that no damage will be done for two or three years. The best of the soil is the first to go, however, especially if the land is cross-ploughed. The finishing furrows should be approximately on the contour, and should not be completely closed. This narrow strip should be left unploughed, and not damaged by cross-ploughing.

(8) *Timber Breaks.*—It is a good practice on tobacco farms to leave contour strips of virgin timber about 10 yards wide every 50 to 100 yards. These strips act as wind-breaks and reduce erosion and run-off, but should be supplemented

by drains in the strips. The lands should be planted so that water from one land does not break into a lower one, but is led off on grade to a natural valley.

Provided the slope is not too steep and the land is returned to a sown grass after two tobacco crops, the system is satisfactory.

(9) *Establishment of Pastures in Vleis.*—To prevent erosion while the grass is establishing itself the land should be protected by low contour ridges of the type made with a disc plough and the ridges first established to paspalum, etc. Next year the strips between the ridges should be planted to grass, and on steep or badly-eroded land this planting should be alternated with belts of sunnhemp, as explained in Bulletin No. 1,016.

(10) *Strip Cropping on New Lands.*—The lines of the contour ridges may be pegged before the land is broken and a strip of grass about 12 ft. wide left for the first season and the ridges constructed the following one. On steep long slopes or on soft erosive soil, and where grass cover is poor, this system would not be satisfactory.

(11) *Rotational Strip Cropping of Gentle Slopes.*—In certain districts with absorptive sandy loam soils and gentle slopes, even on lands as flat as 1 in 200, a much needed quantity of water is lost as run-off during sharp storms, and though not readily visible there is a sufficient loss of soil to justify some measure of protection. After such a land has been storm drained a rotation of strip crops on the contour would do immense good, especially in areas of scanty or irregular rainfall, if the row crops were planted in furrows or "listed."

Is is impossible to definitely state that under such conditions erosion and run-off would be controlled as effectively by contour ridges, but it can be said that there would be a most considerable reduction.

On even or almost even slopes the strips could be parallel as strip crops on extremely gentle slopes can still be satisfactory when the error from the true contour does not exceed half the slope. The width of the strip planted to row crops

Fig. 57 A break in a contour ridge as a result of poor farming methods and neglect of maintenance

Fig. 58 Ploughing in sunnhemp Contour ridges effect little improvement unless the land is well treated, but in that case an increased reward is reaped.

Fig. 59. A recently protected land previously badly gullied

Fig. 60. A badly eroded land restored by contour ridging and seeding to grass. (The figures are standing in the channel and on the crest of a contour ridge.)

Fig 61 A farm road washed out owing to absence of drainage

Fig 62. The discharge from contour ridges washed out this Council road

should not exceed 50 yards, or if split in half by an erosion resistant row crop such as native beans down the middle, 75 yards. The protection strip would be 25 to 35 yards wide and consist of a green-manure crop or grass for hay. For each farm the width of strips could be worked out according to its needs and the rotations used so that there is a progressive rotation of crops along the strips.

The only added difficulty, and a very minor one, over normal farming is that the position of opening and finishing plough furrows should be reversed each year. This is most important if a portion of any furrow is at all off the true contour.

Strip cropping on its own, except as an emergency measure, cannot be recommended at all on slopes steeper than 1 in 100, nor is it satisfactory on heavy or vlei soils.

If on curves, as they nearly always will be, the base lines from which the strips are measured off must be permanently kept by a hedge of Napier grass or similar device.

MAIZE.

COWPEAS, SUNNHEMP FOR SEED, ETC. ↕ not less than 25 yards

MAIZE. ↕ not more than 50 yards

GREEN MANURE OR GRASS FOR HAY, ETC.

GRASS ROTATION.

The practice of alternating crops with pasture "leys" every few years deserves to be adopted. Instead of leaving lands to fallow, they should be planted to a pasture grass,

such as Rhodes grass, which would give excellent grazing and hay. Many farms are short of grazing, since what is usually left for this purpose is poor, rocky, trampled and burnt.

A land planted to grass for 3 or 4 years and then returned to crop production will have given valuable grazing, and received great benefits, provided that it has been fertilised and properly grazed or mown. The fertiliser, manure, humus and fibre in the soil when it is re-ploughed are valuable plant foods, and put the land in better heart to resist erosion. In fact, there is no reason why the land should not be even better than it was when first cleared, since the grass-roots may have loosened the plough-pan, and it may well contain a higher proportion of humus and fibre after a well-grown grass crop than was present in the original veld.

A long period under a thick grass is the only known efficient method of restoring a friable structure to a badly compacted soil.

In some cases the grass can be established by broadcasting the seed and light harrowing of the surface. Common Paspalum (*P. dilatatum*) and the native paspalum (*P. scrobiculatum*) have been established in this way, though the process is slow. Both these grasses seed freely and can choke out less desirable grasses if mowing and grazing is regulated to this end.

The land should be contour ridged with the object of conserving as much water as possible, so that several beneficial results are obtained from the one process.

Details of water conservation on pastures were given in Part I.

Great care should be taken so that the pasture is not grazed at times when the tramping of the animals is liable to pack the soil, as in that case the texture will be so damaged that it would be most difficult to obtain a tilth when it is desired to swich back to crops.

Recovery of Depleted and Eroded Lands.—Where previously to putting in protection works the land is eroded or depleted by over-cropping there may now be a slight increase in crop yields, but a jump up in yields cannot be expected without restoring something to the soil.

A green manure crop must be turned in, and it is usually advantageous and may be very necessary to apply a light dressing of fertiliser to the soil, in order to grow a really good green crop. The fertiliser will not be lost but absorbed by the green crop and made more readily available for the following cash crop. Whilst raw rock phosphate may be all that is needed, in some cases the soil may be deficient in other plant foods, such as nitrogen and potash. Although sunn-hemp is the standard green crop, a mixed crop of Somerset velvet beans and sunflowers has on occasion produced excellent results and is more resistant to drought.

Crop yields after such a treatment usually jump, but the kick is of short duration, as there is no reserve in the soil and it should be built up for a number of years by shorter than usual rotations.

As depleted soils have a lessened capacity for retaining moisture the wider spacings than usual, of maize for example, will tend to give bigger yields.

(Methods of rebuilding and broadening contour ridges will be described later.)

Annual Report of the Agriculturalist.

FOR THE YEAR ENDING 31ST DECEMBER, 1938.

By D. E. McLoughlin, Agriculturist.

Season and Crops.—The season proved a difficult one for farmers. Drought conditions obtained up to the middle of December when the first beneficial rains fell. The late arrival of the planting rains coupled with continuous and heavy rains after mid-December severely handicapped planting operations and the main planting of maize was from two to three weeks later than in normal years. Heavy and incessant rains were experienced in January, and in many parts of the maize belt rain fell on every day of the month. The lack of sunshine in January had a very adverse effect on the maize crop. A severe drought followed in February and lasted for three weeks in parts of the Colony. The rainfall in March and April was insufficient for the requirements of the maize crop. The adverse weather conditions were reflected in reduced yields of most crops.

Maize.—The total European acreage planted was 276,260 acres as compared with 277,612 acres in 1936-37. The total production was 1,432,003 bags, or 5.18 bags per acre, as against 2,039,341 bags, or 7.35 bags per acre in the previous record year, 1936/37.

The Mazoe district produced 549,320 bags, or 7.2 bags, as against 8.9 bags per acre in 1936/37; Salisbury 349,719 bags, or 6.7 bags, as against 8.8 bags; Lomagundi 176,332 bags, or 5.7 bags, as against 7.2; and Hartley 116,636 bags, or 3.7 bags, as against 8.3 per acre in the previous year.

The production in Matabeleland was 108,935 bags from 47,557 acres, or 2.29 bags per acre.

Ground Nuts.—The acreage planted to ground nuts was 5,242 acres, which is 102 acres more than in the previous year. The production was 45,644 bags, or 8.7 bags of 65 lbs. each per acre.

During the last three years the production of ground nuts has been insufficient to meet local requirements and importation was again resorted to in 1938. The average yield per acre is deplorably low and is due to the indifferent treatment accorded the crop. Average yields of 30 to 35 bags per acre have been returned by at least one farmer in the Hartley district, who specialises in the production of the crop.

Sunflowers.—Sunflowers found a profitable level during the year and parcels were exported to England and Australia.

Wheat.—The season was an unfavourable one and the crop again suffered from lack of moisture, due to the early cessation of the summer rains.

The acreage planted was 17,780 acres as compared with 21,976 acres in the previous year. The yield was as follows:—

	Acres.	Yield.	Per acre.
Irrigated	3,615	13,609 bags,	or 3.76 bags.
Non-irrigated	14,037	21,783 bags,	or 1.55 bags.
Total	17,652	35,392	

Although the season under review was less favourable, the yield per acre of both irrigated and non-irrigated wheat exceeded that of the previous year. The total yield was only 6,000 bags less, although the acreage was reduced by 4,196 acres.

Maize Grading and Export—General.—The 1937/38 cropping season was very unfavourable to the growth of maize. The crop was therefore light, and the amount of maize graded for export was in consequence lower by over one and a quarter million bags than in the previous year. Nevertheless the quality of the maize maintained its usual high standard. In fact, the percentage of No. 2 grade maize was 99.31% as against 97.3% in 1937. This is a new record. The amount of native grown maize fell from 257,158 bags in 1937 to 35,474 in 1938.

Staff.—Mr. L. C. Roberts again acted as Senior Grain Inspector, and Messrs. E. C. Gifford and E. F. Holland as Temporary Grain Inspectors for the first time.

Statistics.—The following are the statistics of the maize graded during the year.

(a) Maize Graded by Grading Staff.

Grades.	No. 2.	No. 3.	No. 8.	Rejects.	Totals. Bags.
1. European grown	180,650	980	50	218	181,907
Percentage of total	99.31%	0.54%	0.03%	0.12%	
2. Native grown ...	4,882	28,798	1,284	510	35,474
Total graded by staff					217,381

(b) Maize Graded by Maize Control Board.

Grades.	No. 2	No. 3.	No. 8.	Rejects.	Totals Bags.
	158,865	6,632	4,475	Nil	169,972
Grand total of graded maize					= 387,353

Export of Maize during 1938.

Via Beira 1936/37 crop	90,670 bags.
Via Beira 1937/38 crop	190,921 bags.
To Bechuanaland	150 bags.
Total	= 281,741 bags.

Rusapi Vlei Land Pasture Demonstration Station.—This Station is 14 acres in extent and is sub-divided into seven fenced plots of 2 acres each. The soil is typical swamp, granite vlei-land, and in its natural state is a bog. The land was first broken up in November, 1936, and was contour drained, the drains being spaced approximately 15 feet apart. Agricultural lime was applied at the rate of one ton per acre before the last ploughing. A complete pasture fertiliser at the rate of 200 lbs. per acre was applied to all the plots, excepting in the fertiliser trials, prior to planting, and in 1937 these plots received a top dressing of 100 lbs. of sulphate of ammonia per acre and in 1938 130 lbs. of nitro chalk.

The treatments in the fertiliser trial consist of:—

(*a*) Control (no treatment).

(*b*) One ton agricultural lime.

(*c*) One ton agricultural lime plus 200 lbs. 20% superphosphate per acre.

(*d*) One ton lime plus 200 lbs. superphosphate plus 50 lbs. muriate of potash per acre.

(*e*) One ton lime plus 200 lbs. superphosphate plus 50 lbs. muriate of potash plus 100 lbs. sulphate of ammonia per acre.

(*f*) One ton lime plus 200 lbs. basic slag plus 50 lbs. muriate of potash plus top dressing of 100 lbs. sulphate of ammonia per acre.

(*g*) One ton lime plus 200 lbs. superphosphate plus 50 lbs. muriate of potash plus 130 lbs. nitro chalk per acre.

(*h*) One ton lime plus 200 lbs. basic slag plus 50 lbs. muriate of potash plus 130 lbs. nitro chalk per acre.

The above treatments are applied annually excepting the applications of lime. Two tons of lime have been applied to the one half of each plot and 1 ton to the other half of each plot.

The objects of the fertiliser trial are to ascertain the effect of the different fertilisers and combinations of fertilisers on economical yields of grazing, and the result of their application on the persistency of the clover mixture sown with the two grasses, Rhodes and Paspalum dilatatum.

Pure stands of the following vlei-land grasses plus clovers on two acres each are compared.

(1) Creeping False Paspalum (Brachiaria dictyoneura).

(2) Swamp Couch (Haemarthria fasciculata).

(3) Paspalum dilatatum.

Smaller plots quarter of an acre each of the undermentioned grasses have also been established:—

Paspalum virgatum.

Acroceras macrum.

Tapson's grass (Dicanthium).

Paspalum notatum.

(4) (*a*) Mixed exotic grasses on one acre of the following:

Yorkshire Fog.

Akaroa Cocksfoot.

Wimmera.

Westernwolths.

Perennial Rye Grass.

Phalaris tuberosa.

(4) (*b*) Exotic grasses as in (4) (*a*) plus Paspalum dilatatum and Rhodes.

All the grasses mentioned above were established in association with the legumes, New Zealand White Clover, Giant Cow Grass clover, Red clover, Alsike clover and Lotus major (Greater Birdsfoot Trefoil).

(5) Rhodes plus Paspalum dilatatum.

In all 100 different sowings of grasses and legumes were made in nursery plots.

The outstanding results to date have been obtained with the following grasses:—

Paspalum dilatatum.

Acroceros macrum.

Swamp couch.

Creeping False Paspalum.

Tapson's grass.

With the exception of the first named the other grasses are all indigenous to the Colony.

Owing to excessive drainage and insufficient moisture, the exotic grasses established on Plot 4 (*a*) failed to survive after the first winter. Rhodes grass has made excellent growth on vlei-land and showed much tolerance to the wet conditions obtaining on this station. Paspalum dilatatum, being slow in establishment, provided no grazing in the first year, but made luxuriant growth in the second year and provided excellent winter and spring grazing. In the third season

the Paspalum in the mixed sowing with Rhodes, is obtaining the ascendency and there are indications that Rhodes is weakening and is being gradually replaced by Paspalum.

Results obtained with Swamp Couch and Creeping False Paspalum indicate:—

(*a*) that these grasses require to be established on weed-free land;

(*b*) the advisability of growing a green fodder crop of winter cereals on virgin land the first year.

Being creeping grasses, their runners are lifted off the ground by weeds, which prevent their rapid establishment. Swamp couch proved the slower of the two grasses to obtain the ascendency of vlei weeds. Acroceras macrum made luxuriant growth and was remarkably tolerant of swamp conditions. This grass is very palatable and was much relished by stock. Its cultivation is being extended both on this Station and on the Grasslands Experiment Station, Marandellas.

The legumes made poor growth in the first year owing to the very dense cover made by the Rhodes grass and the acid condition of the soil. After being heavily grazed in the second year the clovers improved, and are spreading. The best growth was made on the plots which received two tons of lime per acre.

In the fertiliser trials during the first season the grasses responded best to the treatment of one ton of agricultural lime. No noticeable difference in the different treatments was observed in the second season, due no doubt, to the waterlogged conditions of the soil.

On the control plots Paspalum dilatatum only has survived, but the growth made on these plots is negligible. Results further indicate that Paspalum is more tolerant to acid soils than Rhodes and that the application of one ton of agricultural lime per acre is necessary for the successful cultivation of both grasses on virgin granite vlei-land.

Improved Pastures.—There has been a noteworthy increase in the interest displayed by farmers throughout the Colony

in this matter, and a considerable area of land has been laid down to improved pastures.

Rhodes grass and Woolly Finger grass have been chiefly used on dry lands, and Common paspalum on the moisture-retaining soils.

The conditions requisite for success in sowing these grasses are not commonly known, and an article on the subject by the Assistant Agriculturist was therefore published in the October issue of the *Rhodesia Agricultural Journal.*

A number of cases have been noted in which a good stand of Rhodes grass has been or is being destroyed by the grass cutter ants and they are undoubtedly a factor which will have to be dealt with in many cases if success is to be had. Fortunately they can be destroyed comparatively cheaply by the use of poison bait.

Winter Pastures.—Interest has been stimulated in this subject and a number of farmers are endeavouring to establish pastures under irrigation, and also on moist soils, of grasses which are frost resistant and make growth during the winter.

Particular interest in winter pasture is being exhibited on the Eastern Border of the Colony, where there are large areas of land which should prove suitable for its production. Co-operative experiments were started by the branch in the South Melsetter district with four farmers in 1936, but unfortunately these have passed the way of most co-operative experiments, although some useful information has been gained. The following grasses have exhibited great hardiness under very severe trial: Yorkshire Fog, Cocksfoot (Akaroa strain), Brown Top (*Agrostis tennius*), Red Top (*Agrostis vulgaris*) and New Zealand Tall Fescue (*Festuca arundinacea*). New Zealand White Clover and Lotus major have also promised well.

Other experiments carried out on Orange Grove Farm by the owner have shown great promise, and in addition to the above Perennial Rye grass and Wimmera Rye grass showed promise; but it is doubtful whether the former will prove to be permanent on the light sandy soils of the area. Although not a winter-growing grass common Paspalum will

give valuable grazing during the greater part of the winter in this area, and it is eminently suited to the local conditions when established on the moist sandy soils. It can be strongly recommended for such conditions, and where white clover can be established with it by inoculation of the seed and applications of lime and phosphate, the combination should give high quality grazing all round the year.

It may also be mentioned here that Rhodes grass has shown great promise for high quality hay, and summer grazing in this area, and can be recommended for these purposes.

Variety trials of winter grasses and legumes have been laid down on Sheba Farm, adjoining Stapleford Forest Reserve in co-operation with the owner, Mr. A. C. Soffe, but it is too early to draw definite conclusions. The grasses and clovers mentioned above are all showing good promise here, and Alsike Clover, Creeping Bent, Meadow Fescue, Chewing's Fescue, Tall Oat grass and Phalaris tuberosa also promise well. The last-named is of particular value as a winter grass where it will thrive and persist, owing to its palatability, quality, and good growth in winter, but without irrigation and high farming its permanence is in doubt until further experience has tested it. It is a grass which requires a fertile soil and an ample though not excessive water supply.

Mr. Soffe is laying down a considerable acreage to winter grasses, and also Rhodes grass and Paspalum, and his experience should be of great value to others.

Experimental and demonstration trials of the most promising grasses and legumes, both summer and winter types, are being laid down under irrigation at Rhodes Inyanga Estate in 1939, with the kind co-operation of the Conservator of Forests. Amongst other problems the feasibility of establishing and maintaining a pasture of mixed summer and winter grasses and legumes will be tested which, it is hoped, may give high quality grazing throughout the year.

Three indigenous winter-growing grasses, which are at present unidentified, show promise of being of value. One of these was collected by Mr. W. F. Filmer on his farm near Inyanga, and the other two by the Assistant Agriculturist in

the South Melsetter district. Another indigenous winter grass (*Agrostis lachnantha*), seed of which was obtained through the courtesy of the Division of Plant Industry, Pretoria, is also under trial.

Lucerne on the Municipal Outfall Works.—At the request of the City Engineer, Mr. Jarvis, the writer inspected a site and advised on the possibilities of growing lucerne on granite soil at the sewerage outfall works on the Salisbury Commonage. A start was made during the year and some five acres have already been established on terraces, the land being irrigated by flooding. The lucerne has made excellent and rapid growth and in the growing season was cut every three weeks. It is the intention of the Council to extend the area under lucerne and to utilise the fall discharge of the outfall works.

Wheat Variety Trials, Rubenvale Farm, Umvuma.—The variety trial commenced in 1934 on the farm of Mr. E. G. Raubenheimer and carried on for four years with his co-operation has been closed, and a new one has been commenced.

In the new trial the variety Punjab 8a, which headed the first trial, has been included in the new trial for purposes of comparison. The remaining nine wheats, with the exception of Florence, are new introductions or hybrids bred at the Plant Breeding Station at Salisbury, which have shown promise in small scale trials on that Station.

The results of the First Variety Trial are given below:—

Variety.	1934.	1935.	1936.	1937.	Mean yield in bags per acre.
Punjab 8a......	8.39	7.86	12.60	6.30	8.79
Lal Kasar Wali	7.32	7.94	12.70	6.68	8.66
Early Gluyas......	8.48	7.48	10.98	6.43	8.34
Kenya Governor......	8.29	6.25	10.48	6.98	8.00
Karachi	6.43	5.62	13.00	5.85	7.73
Quality......	6.55	6.25	11.69	6.02	7.63
Garnet	8.85	6.22	9.17	6.20	7.61
Rhodesia Reward	7.36	5.29	8.36	6.28	6.82

The first year's results of the Second Variety Trial is tabulated below:—

Variety.	Mean yield in bags per acre.
122 D.I.T.L.	9.35
Punjab 8a	9.18
N.B. 230 A	9.07
B.256 b1A.	7.90
Granadero Klein	7.41
131 C.5.P.	6.85
Renown	6.73
Sabanero	6.63
58 F.L.I.	6.20
Florence	6.20
Mean yield	=7.55 bags per acre.
Standard error	=0.77 bags per acre.

Statistical analysis shows that the treatments are significant:

Calculated value of Z	=0.48009
Observed value of	=0.4176

A difference of 3 times the standard error (3 x 0.77) between mean variety yields may be taken as significant, *i.e.*, a difference of 2.31 bags per acre.

Conclusions.—Punjab 8a and 112 D.I.T.L. are significantly better than the last five varieties in the above table. N.B. 230.A. is significantly better than the last four varieties in the table.

Plant Breeding Station, Hillside.—The Plant Breeder, Mr. T. K. Sansom, in his report states: "The year under review was not a favourable one for summer crops. For winter crops conditions were quite satisfactory, the rains in March and April ensured a good moisture supply throughout the winter on the granite vlei-lands.

The maize breeding work was continued. A programme of rice selection and breeding was commenced during the

season, and sixteen varieties are being tested. The crop is being tried both on granite vlei land and under irrigation on a red sandy loam soil.

Wheat Breeding.—The analyses of all wheats have not yet been made, but the analyses to date reveal that the protein percentages are lower than last year. This is to be expected as the wheats took longer to mature owing to the abnormal wetness of the vlei-land and the consequent storing up of starch in the wheat.

A green manure crop of sunnhemp was sown again and ploughed under during the rainy season. No difficulty whatsoever was experienced in growing the crop on very wet granite vlei-land on this station. Even during the extremely wet spell in January and early February when rain fell on 33 successive days, the sunnhemp made good growth up to 7 feet high and was ploughed under towards the middle of February.

Rust.—The incidence of this disease was mild up to the middle of September, when some wheat varieties were fairly heavily infested. Several varieties were discarded. Of the forty-eight selections made from crosses in 1929 only three have been retained; and of the sixty-four crosses made in 1933, fourteen have been retained. Several of the latter crosses show great promise, especially Reward and Wit Klein Koren crosses.

Types have been selected combining the high protein content, strength of straw and early maturity of Reward with the yielding capacity and bearded character of Wit Klein Koren. The types selected mature only a day or two later than Reward, have the same strength of straw and have exceptionally strong black awns.

The protein contents of these crosses vary between 16.58% and 21.40% of the dry matter; this latter figure is the highest so far recorded and is about 5.5% higher than No. 1 Manitoba, with a moisture content of 13.5%. These new crosses are to be bulked up during the coming winter and distributed for trial during the winter of 1940.

During the winter of 1938 four hundred and nineteen varieties and selections were under trial. Forty-four were new introductions obtained from the United States of America, India, Kenya, New South Wales and locally. Many of these new introductions show promise. During the past six years 2,803 varieties and selections have been tried out.

Small Scale Yield Trials.—Small scale yield trials have now been conducted over a period of six years and the following locally grown wheats can be recommended for general sowing. Kenya Governor, Quality, Reward, Droop No. 3, Cawnpore No. 13, Lalkasarwali, Punjab 8a, and Karachi.

It is the writer's opinion that too many varieties of wheat are grown at present in the Colony. The ideal would be to have not more than eight varieties with defined areas for hard red and soft white wheats. It is hoped in time to recommend varieties suitable for the different areas.

Wheat Fertiliser Trials.—The old trials have now been conducted for four years and will be discontinued after the winter of 1939. It is interesting to record that no beneficial effects have been observed from the application of top dressings and sulphate of ammonia on wet granite vlei-land. A comprehensive new series of fertiliser treatments based on the results of the preliminary trials has been drawn up in collaboration with the Division of Chemistry.

Wheat under Irrigation.—Twenty varieties were bulked up under irrigation. The yields were extremely satisfactory. A dressing of 200 lbs. of complete fertiliser per acre was applied, and 50 lbs. of sulphate of ammonia per acre was applied in solution when the plants were four inches high. Approximately 2,000 lbs. of wheats will be available for distribution to farmers for trial next winter, excluding the varieties from the Rubenvale Farm variety trials.

Distribution of Wheats.—One hundred and ninety-three different samples of wheats weighing 1,872 lbs. were distributed to farmers in the Colony and elsewhere.

Out of a total of twenty-seven co-operators who were sent Report forms, only four completed and submitted their returns. This is both very unsatisfactory and disappointing,

as apart from the labour and cost involved in producing the wheats, further additional expenditure will require to be incurred in visiting growers to inspect the wheats on their farms, otherwise the value of the work will be to a great extent lost.

Barley and Oats.—Nineteen varieties of barley were grown during the past season. Three were new introductions from Sweden. Selections continue to be made for a better type of malting barley. Twenty varieties of oats were under trial. Five were new introductions. The variety Jonkersklip *ex* Stellenbosch did not show special promise, being late in maturing. The variety S.171 Ceirch Llwd Cwta from the Welsh Plant Breeding Station, Aberystwyth, and adapted to light soils showed no promise and only reached the tillering stage at the end of September.

Witchweed Control.—The following extracts are quoted from the report of the Assistant Agriculturist, Mr. S. D. Timson:—

"The opening of the 1937/38 cropping season was late and marked by a long-continued spell of wet weather. This was not favourable to the germination of the parasite, and in general the amount of witchweed appearing above ground was restricted. Such conditions are, of course, unfavourable for trap-cropping, since the efficiency of the trap in germinating the parasite is reduced and difficulty may be experienced in ploughing down the trap crop in time."

Trap Cropping.—This method of control, combined with mechanical and hand-cultivation remains the cheapest and most effective means of destroying the parasite where the infestation is severe; and the best crop to use for the purpose is Rhodesian Sudan grass (*Sorghum arundinaceum*). One outstanding virtue of this trap crop is that it is easily killed by ploughing and does not make re-growth from the portions which are imperfectly covered by the ploughing.

Triple Trapping with Rhodesian Sudan Grass.—Moreover, it has been found in a trial carried out last season, with the valuable co-operation of Mr. A. W. Laurie, of Howick Vale, that this crop can be efficiently killed by the use of a disc

harrow when the crop is 5 to 6 weeks old from germination. Two disc harrowings killed the crop very satisfactorily, only two or three plants surviving the treatment.

It would appear from the experience gained in this preliminary trial that the sowing of three successive trap crops of Rhodesia Sudan grass in one season will be a feasible practice, the first two being killed by disc harrowing twice instead of ploughing, at the age of 5 to 6 weeks, and the third one can be ploughed under since it will be ready for killing at the end of March or in early April, when climatic conditions should not interfere with the work.

The soil on which the trial was conducted was a fairly heavy grey loam, but it cannot yet be stated that a disc harrow will be completely effective for this purpose on the heaviest soils. It would almost certainly be ineffective on the heavy black soils, but it is probable that it will be satisfactory on the normal red and chocolate loams on which most of the maize crop is grown. It is being compared with three other systems of trap cropping which are already in use by farmers.

It remains to be seen whether this system of trapping is effective in killing the parasites, but the growth of the second and third trap crops on Mr. Laurie's farm indicated that the parasite had been very satisfactorily killed by the first two traps. If this system of trapping proves to be really satisfactory on the main soil types of the maize belt, it should prove of great assistance to farmers who are combating a severe infestation of the parasite.

Mr. Laurie is himself convinced of the practicability of the system, and is extending its use on his farm.

Munga and Sunnhemp Mixture.—A considerable number of farmers are now sowing munga (*Pennisetum typhoideum*) with the sunnhemp green-manure crop. The two crops grow together very well, but some farmers had a poor germination of the munga, which is probably due to covering the seed too deeply.

The mixture also makes an excellent hay crop. The practice is being encouraged since the munga germinates a

certain amount of witchweed, although its effectiveness in this respect is only about half that of Amber Cane or Rhodesian Sudan grass.

General.—The writer is able to report that on the great majority of farms in the maize belt the control of the parasite is now routine practice. The most generally used method of control is hand-hoeing.

The writer is still of the opinion that trap cropping (Rhodesian Sudan grass is recommended as the best trap) should be much more widely used where the infestation is at all severe. The serious labour shortage makes control by hand-hoeing increasingly difficult, and trap cropping must be used to a greater extent, together with check-row planting and wide-spacing of maize (at 6 feet by 9 inches) combined with machine cultivation.

As evidence of the efficiency of trap cropping it may be mentioned that one farmer whose main crop is tobacco, also grows several hundred acres of maize on severely infested soil. For the past four or five years no destruction of the parasite has been done by hand cultivation as his tobacco crop claims all his labour. This gentleman ploughs in two trap crops each year on one-third of his maize lands. In the first year following the trap crops his yields of maize vary from 14 to 18 bags per acre; in the second year they drop to about 8 to 10 bags per acre.

He finds that this system keeps the witchweed within bounds, and allows him to obtain very profitable yields of maize. In the past he has used Amber Cane, and now employs Rhodesian Sudan grass as the trap.

His experience illustrates admirably the value and practicability of trap cropping as a means of controlling the parasite.

Area under Trap Crops.—That trap cropping is being increasingly employed is shown by the following return kindly supplied by the Government Statistician.

Year.	Acreage under Trap Crops.
1932/1933	1,445
1933/1934	1,796
1934/1935	2,208
1935/1936	2,188
1936/1937	3,003
1937/1938	3,112

Witchweed Demonstration Farm.—The farm Auchendinny at Concession has been acquired by the Government and is to be used to demonstrate the methods of control of witchweed recommended by this Department and to ascertain the costs thereof.

Operations are being commenced in January, 1939, under the direction of this branch.

Spread of the Parasite by Cattle.—An appeal to farmers by the writer to study and report on the question of whether their cattle show any preference for witchweed or merely graze it by accident in taking a mouthful of grass was published in the *Rhodesia Agricultural Journal.*

Only one reply has been received. The farmer stated that he put cattle on to graze the aftermath of wintersome which had much witchweed growing between the rows. They grazed the wintersome, but entirely neglected the witchweed.

Tours.—Two short tours of the Mazoe Valley were made during the year in connection with the control of witchweed. Tours of the Hartley-Gatooma-Chakari area and of the Lomagundi district were also made.

Compost.—The making of compost has been taken up by farmers all over the Colony, and a number of them are already making it on a large scale, one having made over 1,000 tons during the past winter, largely from veld grass with some sunnhemp.

One farmer has composted about 35 acres of sunnhemp on the lines suggested in Bulletin 1,048, Section III., and it is probable that his costs per ton, including depreciation on all implements and the cattle kraals, will be less than 1/- per ton.

The cheapest compost will almost certainly prove to be that made from the maize wastes at the shelling dumps, and from wheat straw, on the lines laid down in Bulletin 1,066. The great advantage of this method, where it can be employed, is that the carting of materials is eliminated, and the handling thereof reduced to a minimum.

One farmer has made 720 cubic yards, or about 360 tons, of high quality* compost from his shelling dump wastes at a cost of £2 for the labour employed in turning the heaps twice. The wastes were fed to oxen in a kraal erected at the shelling dump, and the cost of the kraal and the feeding may be fairly charged against the oxen, since they benefit materially by it.

Three Scotch carts and one wagon were employed for 4½ days in riding and spreading the 360 tons of compost on a nearby field. The average haul was about 1,200 yards, and the cost of labour was £3 15s. 0d.

Experiments on the Agricultural Experiment Station, Salisbury, and others made in Kenya by that Colony's Department of Agriculture, indicate that one ton of compost can be expected to give an increased yield of maize of one bag, where the rate of application per acre is from 6 to 8 tons. If the value of a bag of maize (8/-) is allotted to a ton of compost, it will be seen that this farmer has made £144 worth of compost, for a total cost in labour for turning, carting and spreading it on the field of £5 15s. 0d.

From the experience of one farmer during the past winter it would appear that it is necessary to ensure that compost applied to winter-grown crops such as irrigated wheat shall be completely rotted. In this case the compost was not thoroughly rotted and nitrogen starvation was exhibited by the wheat crop. In the many cases where incompletely rotted compost has been applied to summer crops no ill-effects have so far been noted, and it seems probable that the nitrogen-starvation in the case of this irrigated crop of wheat was due to the low soil temperatures greatly reducing the activity of the nitrifying bacteria. For the same reasons it is considered that the same danger exists in the application of unripe compost to crops grown on moisture-retaining vlei soils.

*It was analysed by the Division of Chemistry.

More striking evidence is available this season of the poor response of maize to dressings of kraal manure in seasons in which the opening two months are excessively wet and cold, and once again compost has shown its marked superiority in this respect. It is of great interest and importance to note that in five out of the past elevent seasons (1928/29 to 1938/39) kraal manure applied to maize on the Salisbury Experiment Station has been ineffective. The reasons for this inferiority of kraal manure to compost have been discussed in Bulletin 1,066 (Section III.). Farmers have reported similar experience of kraal manure to the writer.

Agricultural Experiment Station, Salisbury.—Work has been successfully continued under the management of Mr. H. C. Arnold.

The activities of the Station were mainly concerned with the continuance of the experimental work commenced in previous seasons, a report of which was published in the *Rhodesia Agricultural Journal* for September, 1938. Some of the experiments have been modified as experience has been gained, for instance, in Experiment No. 34 instead of the top growth of the sunnhemp being burnt on the land, it is now cut in the hay stage. In Experiment No. 35 in which the sunnhemp was sown at fortnightly intervals and was ploughed under three months after germination has been amended so that now the sunnhemp is sown over all of the plots before the rains break, and it is ploughed under at fortnightly intervals commencing 1st March, regardless of the age of the material. Another comparison of methods of utilising the sunnhemp in the restoration of soil fertility is being made in Experiment No. 40, where the effect of ploughing under (or cutting) the crop at sixteen weeks *versus* twenty weeks from the date of germination is being investigated.

The possibility of increasing the yields of maize by the use of seed obtained by crossing "selfed" strains is being investigated. The work of selfing individual plants was commenced five years ago. We now have forty-four selfed strains of Salisbury White maize in their fifth generation. Similar work has been commenced with the Hickory King and Southern Cross varieties. During the 1937-38 season crosses

between the more promising of these strains were made, and the seed obtained has now been planted in test plots with ordinary Salisbury White stock.

The mixing of seed of strains which have been selfed for one generation only, and using the crossed progeny thus obtained as seed for the main crop has been advocated by certain authorities. This method has been under trial for three years, but so far no increased yield over that of ordinary open-pollinated stock has been obtained.

Experiment No. 35, maize following sunnhemp which was ploughed under in the previous season at fortnightly intervals, gave results similar to those of the previous season's trials, namely the yields on the plots which were ploughed under after the middle of March yielded very considerably heavier than those which were ploughed under before that date.

The Manager in his report comments on the following points of interest:—

Ground Nuts.—Trials have been conducted over a period of three years to ascertain the effect (if any) of the previous crop on the following ground nut crop. The crops chosen to precede the ground nuts in this experiment were maize for grain, sunflowers for seed, oats for hay, velvet beans for hay, sunnhemp reaped for seed and sunnhemp ploughed under for green manure. The heaviest yields of ground nuts were obtained on the plots which carried sunflowers in the previous season, the average for the three years being 26.4 bags per acre. The lightest yields were 21.9 bags per acre, obtained from the plots which had been green manured in the previous season. There is a difference therefore of approximately 20% in favour of the land on which sunflowers were grown for seed over that which was green manured with sunnhemp in the previous season. Other increases over the green manured land were:—Oats 13.4%, sunnhemp reaped for seed 12.25%, maize 9.4%, velvet beans 8.2%.

Velvet Bean Hybrids.—About one hundred hybrid strains of velvet beans were sown in test plots during the season 1937/38. The less promising of these have been eliminated so that only 33 remain for the 1938/39 trials. These hybrids

all produce a greater total weight of material than the Somerset variety and, with the exception of a few strains, the material consists of a larger proportion of leaves and stalks.

In the 1937/38 trials these hybrids yielded an average of 28% more fodder-without-seed and 36% less seed than the Somerset variety. Their production of fodder and seed combined was 12% more than that of the standard variety, compared with which they mature from one month to two months later. This characteristic should enable farmers to delay reaping the crop for hay until danger of having it spoiled by rain is past, without resorting to late sowing and having to reap a reduced crop in consequence.

Soya Beans—Hay Types.—In the 1937/38 season about one hundred hybrid strains of soya beans of the hay types were included in our trials. The main object of this work is to produce strains which produce as heavy crops of fodder as the best of our older types and have the added advantage of retaining the ripe seed for a reasonable period before the pods dehisce and scatter their contents. The "non-shattering" parent variety has more numerous and finer branches than our standard types, but its procumbent habit, small yield and late maturity reduced its value for farm purposes. As a result of last season's trials these hybrids have now been reduced to thirty for the season 1938/39 trials. All of them retain their seed for at least two weeks after all their leaves have fallen, and the yields of fodder and seed are not inferior to the best of our standard kinds. It is confidently expected that this season's trials will reveal that a few of these strains are capable of yielding more heavily than our standard hay types and that, by reason of their finer and more numerous branches, they will yield fodder of better quality than their parent varieties, and they will thus become an economical source of fodder of the highest quality.

Edible Types.—Some ten strains of yellow-seeded soya beans were obtained from the School of Agriculture at Potchefstroom, and they were included in our trials last season. One of these yielded more heavily than the Herman variety which has hitherto been our best yielder.

By hybridising the Herman variety with a yellow-seeded non-shatter type, some promising hybrids have been obtained. These are now being tested against the Potchefstroom strains and it is hoped that this work will produce varieties of soya bean suited for human consumption and the European market.

Investigations having as their object the discovery of mechanical means of separating sunnhemp fibre from the stalks were continued.

Requests for seed and roots of crops have exceeded those of recent years, and the number of parcels sent out are as follows:—

Free issues of seeds of annual crops to farmers......	290
Free issues of seeds and roots of grasses, etc., to farmers	321
Issues to other experiment stations and schools in this Colony	155
Issues to foreign experiment stations	143
Cash issues to local farmers and others beyond the borders of this Colony	87

The experiment plots this season number approximately 3,612.

Cleanliness Aids Insect Control.

Rhodesian Milk Records.

SEMI-OFFICIAL RECORDS.

Name of cow	Breed	Milk in lbs.	B. Fat in lbs.	Av. % B.Fat	No. of days	Name and address of owner
J. 8 ...	G. Friesland	5453.30	229 50	4 22	258	A. L. Bickle, P.O. Box 595, Bulawayo
Hunyani	do.	5354.40	194.46	3.63	300	Bluff Hill Dairy, P.O. Box 346, Salisbury
Charleston Surprise IV.	P. B. Fries.	7036.00	223.10	3.17	300	
Charleston Richard's Grete	do.	11630.10	495 46	4.19	300	do. do. do. do.
Charleston Joy ...	do.	9633.80	353.21	3.67	300	do. do.
Molly	G. Friesland	9763 90	336 18	3.48	300	Hon. H. V. Gibbs, Bonisa, Redbank
Bess	do.	5604.30	244.00	4.35	300	
Angela	do.	6687.80	232.93	3.48	288	do. do.
Africa ...	do.	8095.90	275.26	3.40	300	do. do.
Mitten	do	8658.90	317.98	3.67	300	do. do.
June ..	do.	8970.30	289.37	3.45	300	do. do.
Julia	do.	7317.50	314 30	4.29	300	do. do.
Janet . ..	do.	10674 90	335.23	3 14	300	do. do.
Iris ...	do.	8073.10	290.09	3 59	300	do. do.
Gwen . ..	do.	8058.80	263 90	3.27	219	do. do.
Fuss ..	do.	7954.70	292.84	3.68	300	do. do.
Bonnie ...	G. Red Poll	7189.00	246 98	3.43	300	do. do.
Whinburn Zephyr .	G. Friesland	7126 50	240 60	3 37	300	do. do.
Grace ...	do.	10065 70	336.53	3.34	300	do. do.
Sweet ...	do.	9428.30	316.72	3 36	300	do. do.
Bertha	G. Red Poll	4448 30	188.40	4 24	223	Gower Hill Dairy, P.O. Box 1143, Salisbury
Snowdrop ...	G. Friesland	7074.90	279.88	3 96	300	
Gower Hill Marion	do	6921.20	261.48	3 78	300	
Betty	do.	8148.90	319.36	3.92	300	do. do.
Paddy II.	do.	5102.00	200.46	3.93	278	W. D. Haywood, Ordoff Farm, Gatooma
No. 24 ...	do.	5677.30	244 60	4 30	234	Matopo School of Agriculture, P/B 19K, Bulawayo
No. 36 ...	do.	5870.60	203.24	3.46	270	
No. 38	G. Ayrshire	5306.50	219.75	4.10	254	
No. 55 ...	do.	6392.40	229.51	3.59	280	do. do.
No. 59	do.	6946 80	236 20	3 40	300	do. do.
No. 66 ...	G. Friesland	5286.60	197 78	3 72	300	do. do.
No. 63 ...	G. Ayrshire	5989.00	222.11	3.70	300	do. do.
No. 62	do.	5065.60	195.40	3.85	300	do. do.
No. 24	G. Friesland	7102 50	249.39	3.51	300	Mazoe Citrus Estate, P.O., Mazoe
No. 23 ...	do.	7312.50	220.40	3.01	300	
No. 9	do.	9427.50	259 45	2.75	300	do. do.
No. 31 ..	do.	9852.00	247.13	3 54	300	Messrs. Meikles Bros., Leachdale Farm, Shangani
No. 154	do.	5967.00	221.95	3.71	247	
No. 21 ...	do.	10860.00	409 34	3 73	300	
No. 71	do.	10231.00	278 22	3.69	300	do. do.
No. 156	do.	10213.00	380.21	3 72	300	do. do.
No. 143	do.	6215.00	250.85	4.03	267	do do.
No. 53	do.	9,669.00	446 52	4.61	300	do. do.
No. 141 . ..	do.	8287.00	308 89	3.72	289	do. do.
No. 61	do.	5268.00	216.73	4.11	243	do. do.
No. 99 ...	do.	7691.00	267.14	3.47	300	do. do.
No. 187 ...	do.	6360.00	258.54	4.06	300	do. do.
Pillow	do.	5372.10	206.61	3.84	300	Red Valley Estate "P" Herd, Lushington, Marandellas
Jane	do.	5528.60	209.89	3.80	275	W. F. H. Scutt, Maple Leaf, Norton
Whinburn Ilex ...	Friesland	7151.60	237.94	3.32	300	Major R. R. Sharp, Whinburn, Redbank.
Whinburn Ruffle ...	G. Friesland	6977.40	230.35	3.30	300	
Saidie	do.	6377.70	204.69	3 26	300	W. Sole, Bauhinia, Glendale
Emma	do.	8001.90	321.59	4.02	300	
Dirko Dot	P. B. Fries.	7359.00	213.98	2.91	300	Union & Rhodesia Mining & Finance Co. Ltd., P.O. Box 80, Salisbury
Dirko Polly ...	do.	8010.50	258.59	3.23	300	
Hedwig	G. Friesland	4929.50	200.18	4.06	261	

Rhodesia Weather Bureau.

JULY, 1939.

Pressure.—Monthly mean pressure was generally 1 to 1.5 mb. below normal over the whole country.

Temperature and Humidity.—Mean monthly maximum temperatures were generally below normal, particularly in the south, where the defect amounted to 4° F. Mean minimum temperatures were slightly below normal, giving average temperatures generally below normal over the whole country.

The humidity of the air as indicated by the dew point was slightly above normal in the south but normal elsewhere.

PRECIPITATION.

Station.	Inches.	Normal.	No. of Days.
Beitbridge	.20	.18	1
Bindura	.07	.03	2
Bulawayo	.01	.05	1
Chipinga	2.18	.60	10
Enkeldoorn	.16	.08	3
Fort Victoria	.59	.10	4
Gwanda	.34	.07	3
Gwelo	.07	.02	2
Hartley	.14	.01	1
Inyanga	.03	.11	1
Marandellas	.16	.07	4
Miami	.14	.06	1
Mount Darwin	.35	.01	2
Mount Nuza	1.36	1.23	10
Mtoko	Nil	.02	—
New Year's Gift	.85	.27	5

Station.	Inches.	Normal.	No. of Days.
Nuanetsi	.41	.23	4
Plumtree	Nil	.05	—
Que Que	Nil	.02	—
Rusapi	1.30	.17	6
Salisbury	.11	.02	1
Shabani	.92	.04	5
Sinoia	.08	.03	1
Sipolilo	.20	.02	2
Stapleford	1.43	1.07	11
Umtali	.69	.30	6
Wankie	Nil	Nil	—
Abercorn	Nil	—	—
Balovale	Nil	—	—
Broken Hill	.09	—	1
Chinsali	.05	—	1
Fort Jameson	.20	—	1
Fort Roseberry	.09	—	1
Kanchindu	Nil	—	—
Kasempa	Nil	—	—
Livingstone	Nil	—	—
Luangwa	.09	—	2
Lundazi	Nil	—	—
Lusaka	Nil	—	—
Mankoya	Nil	—	—
Mongu	Nil	—	—
Mpika	Nil	—	—
Mporokoso	Nil	—	—
Mufulira	Nil	—	—
Mumbwa	Nil	—	—
Mwinilunga	.04	—	1
Namwala	Nil	—	—
Ndola	Nil	—	—
Senanga	Nil	—	—
Sesheke	Nil	—	—
Solwezi	.30	—	1

JULY, 1939

Station	Altitude (Feet)	Temperature in Stevenson Screen at 4 feet °F: 8-30 a.m. Dry Bulb.	8-30 a.m. Wet Bulb.	8-30 a.m. Dew Point	8-30 a.m. Vapour Press. Deficit	Maximum	Minimum	Max. + Mim. ÷ 2	Absolute Maximum	Date	Absolute Minimum	Date	Number of Days Max > 85°	Max. < 70°	Min. > 65°	Min. < 40°	Mean of 24 hours	Pressure Millibars: 8-30 a.m. Station Level	8-30 a.m. 1200 gdm.	Mean of 24 hours	Cloud Tenths	Sunshine Hours
Beitbridge...	1,486	55.9	51.9	49	3.7	72.9	46.5	59.7	80	20	37	31	...	8	...	4	58.7	970.7	885.7	968.8	4.4	...
Bindura...	3,700	56.0	50.3	45	5.0	72.8	43.4	58.1	82	18	38	20	...	8	...	5	...	...	...	..	1.9	...
Bulawayo	4,393	52.6	47.2	42	4.3	68.5	42.7	55.6	77	6	36	8	...	18	...	5	54.9	873 1	885.0	871.8	2.3	9.1
Chipinga	3,685	54.8	51.8	49	2.7	64.4	47 7	56 1	74	6	41	23	.	26	...	...	...	896.5	885.6	...	4.1	...
Enkeldoorn	4,808	52.5	48.0	44	3.8	67.8	43.4	55.6	76	6	38	24	...	18	...	3	...	860.6	885.1	...	2.9	...
Fort Victoria... ...	3,571	50.9	48.1	45	2.3	68.2	44 0	56.1	80	17	34	23	...	14	...	9	55.6	960.0	885.5	898.8	3.5	...
Gwanda...	3,233	54.1	49.2	45	4.4	68.5	44.2	56.5	79	6	33	19	...	13	...	6	...	910.8	885 0	...	3.3	...
Gwelo	4,629	51.8	47.0	42	4.2	66.7	43.2	54.9	75	6	36	6	.	23	...	6	53.5	865.8	865.0	...	2.8	...
Hartley...	3,879	55.0	49.3	44	5 0	72.6	42.5	57.5	79	20	36	8	...	4	...	8	56.0	889.5	884.9	...	1.8	...
Inyanga...	5,503	55.9	48 6	42	6.4	65.2	41.0	53.1	74	6	34	4	...	24	...	15	...	...	...	...	1.6	...
Marandellas	5,453	51.5	47.8	44	3.0	64.8	43.4	54.1	75	6	37	29	...	24	.	4	52.9	...	...	...	2.7	...
Miami	4,090	55.6	50 5	46	4.5	70 2	45.6	57.9	80	5	40	24		14	...	...	56.5	882.5	884.5	881.1	1.2	...
Mt. Darwin	3,179	57.9	53.3	50	4.4	73.8	44.0	58.9	84	6	37	31	...	2	...	6	...	...	...	...	2.4	...
Mount Nuza	6,668	46.3	42.6	38	2.8	53.6	41.3	47.5	68	18	36	29	...	31	...	11	45.4	804 0	885.3	...	5.2	...
Mtoko	4,136	57.2	51.4	46	5.3	69.0	48.2	58.6	78	19	42	29	...	21	...	...	...	881.5	885.1	880.3	2.1	..
New Year's Gift...	2,690	56.0	53.0	50	2.8	70.4	46.7	58.6	80	6	37	19	..	11	...	3	...	...	...	...	...	7.4
Nuanetsi	1,547	55.2	53.3	52	1.8	74.2	39.9	57.0	81	6	35	var	...	5	...	15	...	969.2	885.7	...	4.3	...
Que Que	3,999	53.1	48.2	43	4.3	72.1	44 3	58.2	79	19	38	6	...	7	...	3	56.6	885.9	885.1	884.3	2.5	...

JULY, 1939 (continued)

Station	Altitude (Feet)	Temperature in Stevenson Screen at 4 feet °F: 8-30 a.m: Dry Bulb.	Wet Bulb.	Dew Point	Vapour Press Deficit	Maximum	Minimum	Max. + Mim ÷ 2	Absolute: Maximum	Date	Minimum	Date	Number of Days: Max. > 85°	Max. < 70°	Min > 65°	Min. < 40°	Mean of 24 hours	Pressure Millibars: 8-30 a.m. Station Level	8-30 a.m. 1200 gdm.	Mean of 24 hours	Cloud Tenths	Sunshine Hours
Rusape	4,648	52.2	48.7	45	2 9	66 5	41.8	54 2	77	18	32	24	..	23	..	14	53 7			...	3.0	...
Salisbury	4,831	54.3	48.7	43	4.8	69.2	43 3	56 3	78	6	35	24	..	16	...	3	55.4	859 6	885.0	858.4	2.9	9.0
Sinoia	3,795	53.4	49 1	45	3.8	74 8	38.7	56.7	81	var.	31	20	...	3	..	23		...	...	...	1.3	...
Stapleford	5,304	49.1	46.7	45	2.0	59 2	38 3	48.8	72	18	27	20	...	28	...	18	47.7	..	...	...	4.6	...
Umtali	3,672	55.4	51.9	49	3.1	68.4	47.0	57.7	81	18	41	30	...	18	...	...	56.3	897.2	885.8	895.7	4.2	
Wankie...	2,569	55.8	49 6	45	5 6	79 7	50 8	65.2	87	18	42	20	3	..	..	...	...	931.8	883 8	...	1.1	...
Abercorn	5,458	60 6	53.5	48	6.8	76 5	51 7	64.1	81	5	45	4	...	1	...	...	62.5	839.6	883 8	...	1.1	...
Broken Hill	3,911	55 4	50 7	47	4 2	75 0	47 2	61.1	85	6	39	20	...	7	...	1	59 3	887.5	883.7	...	1 3	...
Fort Jameson ...	3,815	62 1	55.8	51	6.3	75 0	53 6	64.3	84	19	49	29	...	4	...	...	62.6	891 3	884.7	889 7	1.7	..
Fort Rosebery... ...	3,830	58.7	54 5	51	4.0	83 1	48 4	65.7	88	var.	42	var	10	...	...	...	...	..	..	..	..	...
Kasempa	4,500	51 3	47.5	43	3 3	76.8	40 0	58.4	83	var.	...	..	..	1	...	14	..	...	...	...	...	...
Livingstone	3,051	50.7	47.3	44	2.8	77 2	44 5	60.8	85	17	35	8	..	4	...	5	59 6	915.2	883 4	913.7	2 0	..
Loangwa Bridge ...	...	56.9	53.5	51	3.2	83.1	51.4	67.3	90	var.	47	20	6	...	...	...	...	...	...	...	.	...
Lundazi	3,590	63.5	57 3	53	6.2	77.3	42 7	60 0	85	6	34	25	...	1	...	7	59 2	..	...	...	1.3	...
Lusaka	4,193	58.2	51.2	44	6.5	72 9	48 5	60.7	82	6	44	8	...	8	...	..	59 2	878 2	883.6	876.9	2.1	9.4
Mankoya	3,670	51.3	46 2	41	4.1	79.2	41 7	60.5	87	21	30	9	5	...	...	7	59 9		...	.	...	..
Mongu	3,481	57.5	49.8	43	6.9	81.6	51 1	66.4	90	21	41	9	7	1	...	...	65.5	900.0	882.5	898.7	0.5	...
Mpika	4,620	58.4	53.3	49	4.7	71.8	48.2	60 0	83	19	40	17	...	9	..	...	...	865.5	884.1	...	2.4	...
Msoro	3,000	61.8	57.1	53	4.8	82.3	47.5	64.9	90	19	40	var	8	..	...	...	64.9	...	..	...	..	...
Mumbwa	3,500	56.8	50.3	45	5.8	76.6	42.0	59.3	85	18	29	8	...	1	...	9	...	...	..	...	...	...
Mwinilunga	4,450	51.3	47.9	45	2 8	79 9	41 3	60 6	86	18	34	21	1	...	...	5	...	...	...	...	...	...
Ndola	4,190	54.6	50.0	46	3.9	77.7	45.3	61.5	84	21	40	21	...	1	...	...	..	878 4	883.4	...	0.8	...
Chileka	2,600	62.1	56 3	52	6 1	73.2	54.5	63.9	82	var.	49	4	...	6	...	...	63 2	932 5	885.5	...	4.1	...

Southern Rhodesia Veterinary Report.

JULY, 1939.

DISEASES.

No fresh outbreaks of scheduled diseases.

TUBERCULIN TEST.

Fifty-seven head of cattle were tested on importation, of which one reacted and was destroyed.

MALLEIN TEST.

Fifty-two horses and 34 mules were tested with negative results.

IMPORTATIONS.

From United Kingdom: 6 bulls, 2 pigs.

From Union of South Africa: 32 bulls, 26 cows and calves, 52 horses, 34 mules, 1,055 sheep.

From Bechuanaland Protectorate: 266 oxen, 9 pigs, 389 sheep, 20 goats.

EXPORTATIONS.

To Union of South Africa: 396 oxen, 271 cows.

To Portuguese East Africa: 40 cattle, 40 sheep.

EXPORTATIONS—MISCELLANEOUS.

To United Kingdom: Chilled beef quarters, 5,226; frozen boneless beef quarters, 1,657; tongues, 12,456 lbs.; livers, 27,721 lbs.; hearts, 8,186 lbs.; skirts, 5,032 lbs.; shanks, 1,461 lbs.

To Belgian Congo: Beef carcases, 250½; mutton carcases, 29; offal, 471 lbs.

Meat Products from Liebig's Factory.

To Union of South Africa: Corned beef, 38,160 lbs.

To Bechuanaland Protectorate: Corned beef, 156 lbs.

To Basutoland: Corned beef, 240 lbs.

To Portuguese East Africa: Beef fat, 500 lbs.

B. A. Myhill,
Chief Veterinary Surgeon.

SOUTHERN RHODESIA

Locust Invasion, 1932-39.

Monthly Report No. 80. July, 1939.

A few swarms of the Red Locust (*Nomadacris septemfasciata*, Serv.) have been reported during July, the districts concerned being Lomagundi, Darwin, Mazoe, Mtoko, Melsetter and Gwanda.

The size of the swarms has ranged from "small" to "very large," and no definite trend of flight has been evident.

No damage to crops has been reported.

RUPERT W. JACK,
Chief Entomologist.

THE RHODESIA

Agricultural Journal

Edited by the Director of Agriculture.

(Assisted by the Staff of the Agricultural Department).

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Editorial.

Contributions and correspondence regarding subjects affecting the farming industry of Southern Rhodesia are invited. All communications should be addressed to:—The Editor, Department of Agriculture, Salisbury. Correspondence regarding advertisements should be addressed:—The Art Printing Works, Ltd., Box 431, Salisbury.

Agriculture Regarded as Key Industry.—"Agriculture must be regarded as a key industry and it is the expressed wish of the Government that farmers remain on their farms and continue with unabated production," said the Minister of Agriculture, Captain F E Harris, in a special statement in Parliament recently.

"It is apparent from the numerous inquiries which have reached me," said the Minister, "that in spite of the statement published in the Press under my signature, many farmers—particularly tobacco growers—are still in doubt as to the best service which they can render in this time of emergency.

" I wish to make it clear to all sections of the community that the Colony must spare no effort to maintain her normal agricultural output of maize, tobacco, cattle, dairy products, pigs, and so forth.

" While I realise the intense desire on the part of the farmers and tobacco producers to offer themselves for military service, I am convinced that they will be performing an equally, and perhaps more, valuable national service by remaining on their farms and continuing with their normal programme of livestock and crop production.

" If, however, employers in the industry are able to liberate section managers, assistants, or farm pupils of military age, without detriment to the output of their farms, they should communicate the names of such persons to the Secretary, Department of Agriculture and Lands, who will then advise the military authorities that these men may be regarded as released from agriculture.

" Similarly, if the Agricultural Department can be satisfied by partnerships or local committees of farmers that one member of the partnership, or a few selected farmers in any given area, can be released for military service without prejudice to their farms or to crop and livestock production, the Defence Department will be informed accordingly.

" Agriculture must be regarded as a key-industry, and with the above limited exceptions, it is the expressed wish of the Government—a wish to which I am sure loyal adherence will be given—that farmers remain on their farms and continue with unabated production. If more man-power is later required from the industry, steps will then be taken to ascertain from where it can best be drawn.

" Farmers committed to production during the coming season will not be called upon for military service until they have had the opportunity of reaping and disposing of their crops, or until arrangements for doing so, acceptable to them, have been made. No further withdrawals of man-power from the farming community will be made by the military authorities without the consent of my Department."

Notice to Tobacco Growers.—The attention of growers of Virginia Flue-cured and of Virginia Dark Fire-cured tobacco is again drawn to the fact that it is necessary for them to make application for registration each year, in terms of Section 19 of the Tobacco Marketing Act, 1936, as amended.

Application for registration in respect of the season 1939-40 shall be made on or before the 31st October, 1939.

To every tobacco grower known to the Department an application form has already been forwarded. Any grower who has not received a form should report the fact to the Secretary, Department of Agriculture and Lands, Salisbury.

More Spring Cleaning.—As farmers do not want to be hit by any undesirable rebound of Spring, they should refer again to the notes on Spring Cleanliness which appeared in these pages in our September number for a reminder of things postponed, forgotten, or unnoticed. Some further timely hints are as follows:—

Store-rooms, shelling dumps and native compounds are known to be important sources of field infestation by Maize Weevil. Those who grow part of their maize for ensilage should therefore plan, where feasible, to utilise for ensilage the maize growing nearest these sources of infestation. This will clean these lands up early and reduce the numbers of weevil that will later be brought in with harvested grain.

Weeds will now be appearing in the lands. To prevent the breeding of pests that would attack the new crops, these weeds should not be allowed to grow, particularly on tobacco lands—Cleanliness Aids Insect Control.

Warning

to every Maize Grower.

After last wet season, seed maize for this year's planting is heavily infected by Diplodia.

No sample so far tested contains less than 35 per cent.; the majority go much higher.

To prevent crop losses is now a NATIONAL DUTY, and every grower can bear his share of wartime effort by treating his seed against disease.

Normal stocks of disinfectant dusts are on hand, but orders should be placed *immediately*, in case additional supplies are required.

SEED TREATMENT PREVENTS—

Loss of Seedlings.

Lodging, caused by stalk infection (usually attributed to white ants).

Soil infection.

Full particulars obtainable from the Senior Plant Pathologist, P.O. Box 387, Salisbury.

DO YOUR BIT TO KEEP UP PRODUCTION.

Mycological Notes.

12. THE DIPLODIA DANGER.

By J. C. F. Hopkins, D.Sc., A.I.C.T.A., Senior Plant Pathologist.

His Excellency the Governor and members of Government have appealed to all farmers in Rhodesia to make their contribution to the national wartime effort by maintaining crop production at the highest possible level. The moment is therefore opportune once again to bring to the notice of all maize growers the serious losses which are occasioned every year by the several fungi grouped under the name of "Diplodia."

It has been shown in various parts of the world that seed treatment alone increases yields of maize, planted from ordinary farm-selected seed, by between 5 and 10 per cent.

A similar condition obtains in Rhodesia. The statement may be put another way by saying that "Diplodia" causes losses amounting to at least 10 per cent. of the crop annually. In other words, something like 200,000 bags of maize are utilised every year to feed a group of parasitic fungi. Now, those 200,000 bags of maize are urgently needed to feed some portion of the Empire, and it becomes the duty of *every* grower to save *every* bag that he can from the devouring parasites which abound wherever maize is grown.

A notice in this issue of the Journal calls growers' attention to the urgency of treating seed this season in view of the high percentage of infected kernels present, for it is felt that if such badly diseased seed is planted, not only will poor stands be obtained but a great increase in soil infection will also follow. With the prospects of a long war in front of us, we must take every precaution possible to minimise the chances of establishing serious diseases in our arable land. For, if men are withdrawn from the countryside, the task of

those left to "keep the home fires burning" will not be lightened by having to cultivate old, diseased lands.

In appealing to farmers to treat their seed it must be pointed out that "Diplodia" is too widely established in the Colony to be completely eradicated by such a simple and cheap method. Seed treatment aims at protecting the young plants from invasion by the fungi present in infected seed. Few farmers have any idea how much growth can be retarded by the activity of even weak parasites, let alone such virulent fungi as the "Diplodia" group. It has been estimated from results of carefully designed experiments, that if it were possible to eliminate all the organisms with which a crop such as wheat has to contend during its life period, then the normal yield would be increased twenty-five times. With such a possibility in view, it is obvious that every one engaged in agriculture can do his share in the task of saving essential commodities from the ravages of disease and thus increasing yield per acre.

Seed treatment is one way of assisting, for not only does it protect the young seedlings and reduce soil infection, but it also protects the mature plant in a way unsuspected by most growers.

When "Diplodia" attacks a young maize plant, the latter may have sufficient vigour to withstand the parasite and continue what we usually regard as normal growth. The fungus, however, is not completely thrown off, and when the plant approaches the end of its days, the fungus again becomes active, grows into the pith of the stem and into the roots, making them weak and brittle. At the time when the cob is ripening or drying out, the whole of the surface root system may be rotted by "Diplodia" and the plants easily fall down. Very frequently, of course, white ants are to be found tunnelling in the roots and stem and the initial damage is invariably attributed to these creatures. The fact remains, however, that "Diplodia" is the nigger in the wood-pile and that is a further reason why seed treatment is urged —to eliminate stalk infection in the young plant. Seed treatment costs about 1½d. per acre and the labour involved in treating seed is much less than that required to pick up

fallen mealie plants. Quite apart from any other consideration, a saving can be effected in this direction.

The above recommendations are designed to remove what may be called the invisible losses due to "Diplodia." The control of the visible losses, *i.e.*, mouldy cobs, depends, however, on other factors.

Cobs are directly infected, usually by way of the shank or the tip by spores blown from diseased stalks, cores and cobs left lying about the farm. If mouldy grain is going to be got rid of, then growers *must* improve their methods of thrash disposal. It is particularly important that the bottom three joints of the stems be destroyed and not imperfectly ploughed under. If ploughing under is resorted to, then the job must be done early in the year and the stumps well buried.

Trash, including shelled cores, may be used for feeding or composting, but in either case, it must be fully disposed of if cob infection is to be eliminated. Recent research has proved that "Diplodia" is destroyed in the digestive tracts of oxen, so that kraal manure need no longer be suspected of harbouring disease. Growers, therefore, have three alternative ways of disposing of infected stalks.

(*a*) By ploughing in deeply early in the year.

(*b*) By composting all the stalk, husks and cores.

(*c*) By feeding to cattle.

If whole plants are pulled out by the roots and stooked, carted to compost heaps and kraals for complete disposal, there should be little diseased material left to infect subsequent crops.

It has also been proved recently that "Diplodia" infection in the field increases with proximity to diseased stalks, so that the obvious remedy is the removal of such stalks. This, of course, applies to all maize refuse which may harbour the fungi.

There are other phases of "Diplodia" which will be dealt with at a later date, but it cannot be too emphatically stressed that for this coming season, at least, treatment of maize seed becomes a civic duty.

Some Factors Affecting Seed Potatoes.

By E. T. MORGAN. Officer in Charge, Potato Branch.
Department of Agriculture of Western Australia.

Western Australia is unique in the fact that practically one variety of potato only is grown throughout the producing areas of the State, namely, the "Delaware." The question which often arises in other countries, where many sorts are usually produced, " Which variety shall I grow? " is therefore seldom asked.

The "Delaware," which was introduced into this State from the United States of America in about the year 1910, has proved itself to be a wonderfully consistent cropper and does well at all times of the year in our varying classes of soil. There is, in my opinion, a great merit in having only one variety, as it is reasonable to suppose that one variety can be maintained in a greater degree of health than is possible in dealing with a large number of varieties. The various virus diseases manifest themselves differently in different varieties, therefore a multiplicity of symptoms would be discernible when many kinds are grown, thereby complicating to a great extent the preservation of even relative freedom from such diseases.

In the past it has been the common experience of potato growers in nearly all parts of the world that, sooner or later, varieties have degenerated to such an extent that they became unprofitable. It has often been heard that potatoes have " run out," and this degeneration has been greater in some varieties than in others. It is interesting to note that some of the present-day popular varieties were introduced many years ago. For instance, the Brownell's Beauty, which is the favourite variety in Tasmania, was first produced in the year 1873, while our Delaware was produced in America in 1888. Some varieties have been found to have degenerated in a comparatively short space of time.

Following the introduction of the Delaware variety into this State, little trouble in our seed stocks was noted, in spite of the fact that little or no selection was made, and small or "round" seed was mostly used. After a while, many growers, working on the assumption that "like produces like," used large tubers and cut these into sets for planting, and improvement in crops was noted. About 18 years ago, however, it became noticeable that, in spite of this apparent selection, all was not well with our stocks, as various plants in fields showed curly leaves and stunted appearance. Some growers went a step further in selection and dug out apparently healthy, well-grown plants, saving the tubers for seed purposes, but even then some signs of trouble were still noted. About this period, literature from other parts of the world stated that virus diseases were increasing and mosaic and leaf roll, two types of these diseases, were described.

It was thus possible, with the aid of the Plant Pathologist, for us to begin to assign the reason for the degeneration of stocks. There is, at present, much research work going on in relation to virus troubles and in America many different forms in the potato are recognised. In this State, however, mosaic and leaf roll are mostly in evidence, the first-named manifesting itself in a mottling and crinkling of the foliage, and the latter in a general dwarfing of the plant, with a rolling of the lower leaves, the plant yellowing prematurely, and the yield from these plants being greatly affected.

These diseases live in the sap of plants, and are not arrested by sprays or other treatments which are effective in controlling other diseases in plants. Unfortunately, these virus troubles are transmitted from unhealthy plants by such sucking insects as aphids, thrips, leaf hoppers, etc., to healthy plants. This is the reason why, when the lifting of apparently healthy plants and the tubers from these have been planted, that the succeeding growth has been found to be affected with disease. It will thus be seen that if we are to maintain the productiveness of our stocks, great care

in selection is necessary; the only control of these diseases is by the eradication of the diseased plants in our seed plots as early as possible.

In 1926 the Government Certified Seed Potato Scheme was introduced, and by the use of such seed, the virus disease infection has been kept at a minimum. About this period, seed stocks in the South-West were so badly affected that yields in many cases were reduced to 2 tons and less per acre. The introduction of "certified" seed from the Great Southern area, the Denmark, Young's and Kalgan River districts especially, revolutionised the industry in the South-West, and to-day such seed and its near progeny has continued to give excellent crops, our high average of more than 5 tons per acre speaking for itself.

The improvement of the potato by selection is a field of endeavour in which every grower interested in the problem of increased production per acre can engage, but it is practically impossible for the grower to maintain freedom from disease in the commercial plot. This can only be done effectively in a special seed plot which should be well isolated from possible infection from a commercial area, a minimum distance of 200 yards should be allowed from other growing potato plants. The best and only reliable time to establish the seed plot is in the winter, as any virus diseases are more easily determined in colder weather, high temperatures such as are experienced in the summer-grown crop have the effect of somewhat masking these diseases, the symptoms do not show so readily, and greater difficulty is experienced in detecting and eradicating affected plants.

Again, in the colder weather, insects such as aphids and thrips are not so plentiful and the risk of transmission of disease is minimised. This is the reason why, in other countries, it is usual for seed to be purchased from colder parts for planting in warmer areas, such as seed being bought in Scotland for planting in England, and much of the seed in the United States of America, from Canada. In these countries, one main crop per year is planted, while in this State potatoes are grown practically all the year round, and it is thus possible for us to establish seed plots at that

"Sets" from tubers from a single plant One "set" is showing a normal "shoot" and the other two show thready eye sprouts.

time of the year where practice has taught us that best results are obtained.

In the establishment of the potato stud seed plot, it is desirable that the seed shall be taken from apparently healthy, well-grown, true-to-type and heavy-yielding plants, and preferably from the heaviest type of land in our swamp or summer land. These plants could be staked or marked in some way during the growing season, avoiding, if possible, the staking of any plants in the near vicinity of any other showing mottling or crinkling of the foliage and dwarfed and leaf-rolled plants. It is good practice to keep the tubers from each root separate, these can then be planted separately in the seed plot, allowing a small space between each planted root of tubers, so that any plants which may have picked up infection in the growing stage will be together, and eradication of the whole series of roots carried out. A further and more elaborate method that can be adopted in the seed bed is what is known as the tuber unit system. Selection is made as quoted, but instead of each root being separated, each tuber is treated as a separate unit. Each potato is cut into sets, if large enough for cutting, and the sets from each tuber are planted consecutively, allowing a double spacing between this unit and the next, and so on, until the seed bed is planted.

This latter method has been introduced in connection with the certified seed scheme, the first plot being planted in the Denmark area in August, 1937. In this area, such a procedure as a measure for good seed production, is a practicable proposition because only quite small areas are grown in this so-called winter planting. It is usual to employ planting boxes when sowing the crop, so that the sectioning of such planting boxes is easy. A half fruit case (flat) can be divided into six sections, and a kerosene case cut through on the side can be divided into 12 sections. It is thus possible to cut a tuber into each section and planting can be carried out with little loss of time.

The tubers from this crop, after effective "rogueing," are again sown in about March (autumn planting), which crop is harvested in July and August, and this provides seed

for the main swamp crop planting in November and December and harvested in March and April, and which supplies certified seed, available for main crop planting in the South-West areas during June, July and August.

This method allows us, in the case of any of the plants in any unit being affected with disease, to wipe out the whole of such unit. It is desirable to wipe out any unit that shows even one plant to be affected, as it is possible that part of a tuber may be badly affected and easily recognisable, whereas other parts of the same tuber may be affected in a lesser degree, and be not easily discernible, so that by the eradication of each complete unit we shall stand a reasonable chance of obtaining disease-free stocks. By this method badly affected stocks have been cleaned up in a short time.

It may seem strange that one part of a tuber can be affected more so than another, but, according to research work done in various parts of the world on the transmission from diseased to healthy plants, it appears that something like 18 days must elapse before disease reaches the tubers after the inoculation of the plant. It will thus be seen that progress is slow and explains why some tubers or even part of a tuber on the same root are affected, while others appear to remain healthy. The crop may come to maturity and be harvested prior to all the tubers becoming affected. Once we have obtained good seed, it is possible, with care and attention, to keep it productive over a number of years, especially if we can grow under sufficiently isolated conditions, so as to avoid contamination from other crops that may be diseased. It is practically impossible to keep our seed perfect, but if the grower takes all precautions, he has a reasonable chance of maintaining it at a high degree of freedom from these virus diseases.

Another problem we are faced with in our seed tubers in summer-grown crops is so-called "thready eye," or "spindle sprout." This shows itself in the failure of the tuber to produce a normal shoot, but a thin thread-like growth is sent out from the eye and, when the potato is planted, this weak shoot seldom emerges above the ground. This trouble has been found to occur in tubers grown mostly in the light sandy peat

swamps in the Albany and other coastal districts. Unfortunately, no symptoms are noticeable in the growing plants, and it is often found in the larger tubers from well-grown plants.

No special work has been done in this State on this trouble, but observation tends to the belief that this result is brought about by lightness of soil and high temperatures during the time when the crops are coming to maturity. This observation is strengthened by the fact that the larger tubers are generally affected, while little is noted in the smaller potatoes. It is usual for the larger tubers, in any potato crop, to be found near the surface, and these would be more affected by heated conditions, while the smaller tubers generally found lower down on the same roots, being often in moister soil, are not so affected and little trouble is noted.

It would therefore appear that heated conditions at some stage of the growing period impair the vegetative vigour of the seed tuber for future planting, for it has been noted that where heavy crops of greenstuff have been ploughed in so increasing the humus content of the soil, thereby minimising extreme difference of soil temperature, that this trouble has been very considerably reduced. This ploughing in of green-crops is, therefore, advocated in an attempt to control this trouble.

Experimental work in the production of seed in the southerly parts of America where temperatures are high, have demonstrated that a mulch of straw or other litter was found effective in increasing the vigour of the seed, which again tends to show that the seed is obviously affected by extreme heat. Whilst this is practicable in a small seed plot, it would be difficult on a large area.

The following photograph shows tubers which were taken by myself from a single plant and planted with results as shown. The "sets" from the large tuber show "thready-eye" sprouts, while the other shows a large, healthy, sturdy shoot. I am not forgetting the possibility of virus disease in such a case, but this appears rather improbable on account of the fact that I can instance that seed from the same plot has been planted on different locations with the result that from one soil type so-called "thready-eye" has shown prominently

whereas in the other case no such trouble has occurred. Seldom, if ever, do we find this trouble from tubers grown in heavy soil types when the crop comes to maturity under reasonably cool weather conditions.

As well as "thready-eye," a certain lack of vigour in seed which has been produced in light soil types has been noted. Such, when grown alongside seed which has been produced in heavy soils, has failed to give corresponding crops and yields have shown 1 to 2 tons per acre in favour of the heavy soil type seed. When this unthrifty seed is again grown in heavy soils, if free of leaf roll and mosaic, a pick-up in vigour is noticeable. This weakness may be bound up in lack of certain nutrients required by the plant and tubers, and it was suggested to me early in 1937 by an officer of this department, that copper may be needed in order to build up the vigour of the seed. Recent experimental work in the Albany area in conjunction with the Plant Nutrition Officer (Dr. L. J. H. Teakle) and observations have tended to support this theory.

It has been stated by many growers that the use of immature seed results in heavier yields, but it is hard to understand why, when seed of almost any other plot should be fully developed, the potato tuber should be treated differently. Experiments conducted in various parts of the world have, however, indicated that the planting of immature seed has been attended by heavier yields, while other experimental work has shown that no advantage has been gained by its use. Advocates of immature seed aver that for the production, the proper water and nitrogen contents of the tubers are obtained just about the time the tops show the first signs of ripening. The evidence in favour of unripe seed is so strong that one cannot lightly disregard it, but recent work has shown that a crop lifted in an immature state is not so long exposed to virus disease infection as is one which is allowed to ripen completely. It may be stated, therefore, that the one important advantage of using immature seed may be due to comparative freedom from transmitted diseases and that evidence points to the immature seed being less vigorous than ripe seed when diseases are absent. It will also be readily appreciated that the

storage of seed, which has to be done for some considerable period in the Great Southern areas, will be more successful when the tubers are well ripened before being harvested.

It has been discovered that where black spot or "early blight" makes its appearance in the potato tops, as it often does in autumn-grown seed crops, if the tubers are dug on the green side so-called storage trouble develops, but where the potatoes are thoroughly ripe when harvested, little damage ensues during storage.

(To be continued.)

Cleanliness Aids Insect Control

Pyrethrum.

By H. C. Arnold, Manager, Agricultural Experiment Station, Salisbury.

Several decades have passed since the insecticidal properties of powdered pyrethrum flowers were first discovered. There are several species of pyrethrum, some of which are grown in flower gardens, but the only species of commercial importance is known as *Pyrethrum cinerariaefolium*. It was first discovered in Yugoslavia, and until the latter part of the nineteenth century, the islands in the Adriatic Sea and the adjacent mainland (known then as Dalmatia) produced the greater part of the requirement of commerce. The crop was found to thrive in Japan, and after the outbreak of the Great War production in that country rapidly increased and it became the chief exporter. During the years 1929 to 1931 the average annual Japanese crop was nearly 14,000,000 lbs., the greater part of which was exported to European countries and the United States of America. During the past decade its cultivation has rapidly increased in Kenya Colony, and it is regarded as the most remunerative exportable crop grown in that Colony at the present time. The adoption of scientific methods of cultivation and the manufacture of standardised extracts of the active principles of the flowers have largely contributed to the success attained.

Pyrethrum may be considered a hardy crop because it can be grown under widely differing conditions of soil, rainfall, heat and altitude. It has been successfully cultivated in England at a few feet above sea level and it withstands the rigours of the English winters without artificial protection. Yugoslavia and Japan are both approximately forty degrees north of the Equator. In the Adriatic islands the crop is grown at altitudes below 3,000 feet; in some districts there are frequent heavy rains, while others are arid, and temperatures range from several degrees below freezing point to 90° F., or even 110° F. in certain areas. In Kenya

Colony, which is near the Equator, the crop thrives as well at altitudes of 6,000 feet to 10,000 feet as it does at sea level in the other countries. In its native habitat it is grown on poor calcareous soil; in Kenya the soils give a slightly acid reaction. It succeeds well on the red soil and on sandy soil in this Colony. Although it will produce a crop of flowers on soils which are lacking in fertility, it responds to dressings of manure and fertiliser, but these should not contain excessive amounts of nitrogen, for that element is said to encourage the production of many leaves and few flowers. Pyrethrum can resist frost and drought, but it cannot tolerate a water-logged condition of the soil. The coastal regions of Dalmatia enjoy an annual rainfall of 40 inches, but rain is rare in the summer months. In this respect the Dalmation climate differs from that of this Colony, and this explains the reason for the greater productiveness of locally grown crops when water is applied during the winter and spring months.

During recent years investigators have found new methods of using the insecticidal properties of this plant, so that instead of its being used in the form of powdered flowers almost entirely, extracts are now made which are used in liquid form in houses, gardens and stables or wherever a non-poisonous insecticide is required. Although the active principles of pyrethrum are highly toxic to insects, they are harmless to mankind and warm-blooded animals, thus forming an almost unique combination of qualities. For this reason it can be used in sprays against insects attacking fruit trees at times when it would not be possible to use arsenical or other poisonous sprays. There is a possibility of future investigations showing that pyrethrum can be used in this Colony and neighbouring States against insects which attack citrus and deciduous fruits which at present are difficult to control, so that a local demand of some importance may arise.

This wider range of usefulness has increased the demand for the pyrethrum flowers, and with the object of finding whether the crop could be grown under local conditions, seed of *Pyrethrum cinerariæfolium* was obtained through the courtesy of the Director of the Plant Pathological Laboratory of the British Ministry of Agriculture in the year 1931.

A part of the plants raised from this seed were planted on irrigable land, but the majority were planted on land which receives the natural rainfall only, which, for convenience, may be termed "dryland."

Pyrethrum on "Dryland."—Sowings in seed-beds were made at intervals from July, 1931, to September in the same year, and the resulting plantlets were transplanted to the open ground soon after the seasonal rains set in. A very satisfactory stand resulted, and the plants progressed satisfactorily and continued to form side-shoots until the following August. The hot and dry weather experienced during September and October caused them to flag and retarded growth. They recovered soon after the rains commenced and 40 to 50 per cent. of the plants produced flowers in the following months of January and February. The remainder of the plants produced no flowers either during that season or in subsequent seasons. In the second season a smaller proportion of the plants produced flowers, but about 2 per cent. were much more productive than the others. Seed of these was saved; and by continued selection, a strain of pyrethrum which is much more suited to local conditions than the original stock has now been established, but the lack of rain during the winter and spring months impairs the vitality of the plants and defers the flowering period until the rainy season, when difficulty in drying the flowers is experienced. Under the conditions obtaining at this Station, which is representative of the maize areas of the Colony, the growing of pyrethrum on dryland cannot be recommended as a commercial proposition. Only in districts where a few inches of rain is precipitated during the winter months could the crop be expected to thrive without artificial applications of water during the winter and spring months.

Pyrethrum on Irrigated Land.—Much more promising results have been obtained from small patches of the improved strains when these have been grown under irrigation. Visitors to this Station who have grown the crop in Kenya Colony have remarked on the thriftiness and profuse flowering of these plants. The yields of dried flowers gathered from these patches have ranged from 400 lbs. to 1,200 lbs. per acre. Such yields indicate that in districts in which

water for irrigation purposes can be obtained at low cost this improved strain would yield crops of flowers as abundant as those produced in other countries where pyrethrum is grown for commercial purposes, and there is every reason to believe that its cultivation here would be as profitable as it is in Kenya Colony or elsewhere, if the industry could be established on a similar sound basis. Samples of flowers grown at this Station have been submitted to oversea firms who handle the Japanese crop, and their reports affirmed that the samples submitted had the same market value as the flowers obtained from the other country. Market prices fluctuate according to the supply and the demand, but about 8d. per lb. for the dried flowers may be taken as an average, though prices as low as 5d. per lb. and as high as 2s. per lb. have been recorded. In recent years there has been a tendency to base the value of the flowers on the percentage of pyrethrins they contain, as revealed by a chemical test. As the pyrethrin content of commercial samples varies between 0.4 to 1.2 per cent., it will be seen that the best samples are worth three times as much as the poorest. The difference is almost entirely due to the methods of gathering and drying the flowers.

The question will arise as to whether pyrethrum growing is likely to be found to be as profitable as other branches of agriculture which are already established. The crop demands intensive methods of cultivation, and its requirements are in some respects comparable with those of tobacco, though less skill is required for curing, and the risks are fewer. The cost of growing the two crops would be somewhat similar, both are raised in seed-beds and afterwards transplanted in the open fields; both are reaped by hand, dried, and eventually baled and exported. Pyrethrum requires about 44,000 plants per acre as against 5,000 for tobacco, but some four or five crops can be obtained from each planting. Transplanting can be extended over several months, and the old plants can be divided and re-established if desired, instead of using seedlings, so that if the cost of establishment is spread over the number of crops which result, it will probably be found that these costs do not differ widely from those incurred in the cultivation of tobacco. The gathering of the flowers is

a more tedious operation than picking tobacco leaves, but subsequent treatment does not require much labour or skill, and it is thought that the costs involved for harvesting and preparing for market will be less for pyrethrum than they are for tobacco, while the risks incurred in these operations are definitely in favour of pyrethrum. The yields obtained and the prices are about the same for the two crops, and in both cases wide fluctuations occur. Tobacco farmers who own irrigable land might find pyrethrum growing a convenient and profitable side-line. When grown under irrigation the main crop of flowers are produced during the months of October and November, with a smaller crop in December and January. The labour force kept "standing by" awaiting favourable weather conditions for transplanting the tobacco could be utilised for gathering the main crop of pyrethrum flowers. During December the wet days would favour the work with tobacco and the dry days would be devoted to harvesting pyrethrum; and during that period the barns would be most useful for drying the flowers. The bulk of the pyrethrum crop could be harvested and dried before the barns are required for curing the tobacco.

A comparison between wheat and pyrethrum growing may be made, because both require irrigable land. The initial cost of establishing wheat is much less than that of pyrethrum, but that cost recurs every year, instead of once in four or five years for pyrethrum. The value of the wheat crop will not exceed one half of that of the pyrethrum crop. Weight for weight, the pyrethrum flowers are worth five times as much as wheat, and this would allow pyrethrum to be grown in outlying areas in which wheat growing is not profitable because of the cost of transport to railhead. Furthermore, the monetary returns per unit area are comparatively high, and this would enable farmers to make a living from a smaller area of irrigable land under pyrethrum than is possible with wheat.

After the first cost of planting out the pyrethrum has been incurred, little further outlay is necessary until the crop is ready to harvest, and the expenditure required for that will be proportionate to the marketable material obtained. It appears therefore that there are distinct possibilities for

pyrethrum growing. Few farmers will wish to change suddenly from the crops they are accustomed to, but those whose land is situated in districts which are too cold for tobacco, too far from railhead to permit of wheat being marketed, or where the wheat crop is frequently injured by frosts, might give the crop a trial by establishing a few acres from which its potentialities could be gauged.

A small quantity of seed reaped from the most floriferous plants of the selected strains produced at this Station is available for distribution to Rhodesian farmers who would like to give this crop a trial.

RAISING SEEDLINGS.

Seed-beds similar to those used in the raising of tobacco or tree seedlings are suitable for pyrethrum also. The soil should be made fertile by the addition of suitable fertilisers, and the surface should be fine and level. The beds should be protected from the drying effects of the wind by grass screens, bricks or other suitable material, and grass mats or hessian should be available for shading the beds from the sun. One pound of seed is sufficient for 300 square yards of seed-bed, and the young plants will cover about 10 times that area when they are transplanted in the field. The crop prefers well drained sandy soil, and seed-beds which are well supplied with organic matter will provide the best transplants.

Soak the seed overnight and then wrap in sacking and bury in damp sand for 4 or 5 days. Before sowing mix the seed with white sand to facilitate its even distribution over the surface of the seed-bed, and after sowing, very lightly cover with sifted sand. Water thoroughly and keep shaded from the sun until germination is completed. This continues for 5 to 25 days after sowing. Gradually reduce the intensity of the shade and entirely remove the shading material on the first cloudy day which occurs after the seed has finished germinating.

When the seed is sown in August or early September the plants will be three to five inches high at the commencement of the seasonal rains, and they should then be transplanted to the field. The rows should follow the contour of the land as closely as is practicable.

The plants should be set at 6 inches to 12 inches apart in the rows, and these should be from 18 inches to 24 inches apart. Carefully avoid planting the seedlings too deeply, as this is said to cause leafy growth and to inhibit the production of flowers. After planting, the only attention required is to keep the land free of weeds until the flowers appear.

In the northern countries the whole crop of flowers is produced within a short period and they are reaped in one operation regardless of the stage of maturity. Research work in recent years has shown that much of the insecticidal value of the crop will be lost if the flowers are plucked a few days too early or too late, and it has become the practice on modern pyrethrum farms to gather the flowers every day, just as soon as they reach the stage of optimum maturity.

Careful examination of one of the daisy-like flowers shows that it is composed of numerous florets. Those at the outer edge have conspicuous white petals or rays, while the yellow disc consists of scores of tiny florets arranged in concentric rings. The outermost ring, to which the white petals are attached, reach maturity first, and this stage is marked by the opening of the flower. These are followed by the next ring, and so on, day by day one or more of the rings of florets reach maturity and open, until finally the centre is reached. In order to obtain the maximum amount of the active principles which are known as Pyrethrin I. and II., the flowers should be gathered when two-thirds of the florets have opened, but those at the centre of the disc are still immature. As the stalks have no commercial value they are not gathered with the flower heads, which are picked by placing two fingers under the head and the thumb on the top, then by bending the head over and giving a slight pull at the same time, the stalk may be snapped off close to the head. In this way the addition of useless material may be avoided and better prices will be obtained.

After picking, the flowers must be dried before they can be stored and finally baled for market. In order to obtain the bright colour which the buyers prefer in the dried flowers, they must be dried quickly and thoroughly. There is some diversity of opinion as to whether there is any advantage in drying the flowers in shade, and as it appears that

little harm will be done by exposing them to sunshine, where the drying will be more rapid and effective, this would seem to be the best method. The gathered flowers must be protected from rain, or their value will be reduced. Drying requires 5 to 10 days, and should be continued until the flowers can be crumbled between the fingers, after which they should be packed in containers which will prevent them from re-absorbing moisture from the air. When the crop is grown on a large scale, and particularly in mountainous districts, where cloudy and misty weather is more frequently experienced than sunny days, it will be necessary to erect an artificial drying plant.

The dried flowers are packed for export in compressed bales after the manner of cotton and similar materials.

CLEANLINESS AIDS INSECT CONTROL.

Compost.

By S. D. TIMSON, M.C., Assistant Agriculturist.

[*This article was first published in the November,* 1937, *issue of this Journal and reprinted as Departmental Bulletins No.* 1048 *and* 1104. *The complete stock has again been exhausted, and requests are still regularly received. It is therefore necessary to republish, and the opportunity has been taken to add to and revise it in the light of further experience.*

Introductory Note.—The process of making compost is essentially a simple and elastic one from the practical farm standpoint, but the desirability of assisting farmers to adjust it to suit their own particular conditions has forced the writer to elaborate certain aspects so that they may understand how to do this.

The farmer who does not want to know what happens inside the compost heap, and is not particularly anxious to achieve a perfect product in the minimum time, need merely read those sections describing the actual handling of the materials or the proportions of them required.

The writer has found, however, that many farmers are also keenly interested to understand what is happening during the process of decomposition, so that they can the more intelligently utilise the resources of their farms in the way of raw materials to the best possible advantage, and for this reason he has included a brief description of the processes of decomposition of the organic matter and a discussion of the ways and means of speeding up or retarding those processes and making them as economical as possible.

The article has therefore been arranged in sections with the hope that readers can find what they require and neglect the rest without waste of their time.

Section III. deals with a suggestion the writer makes for composting the sunnhemp crop, with the object of reducing the proportion of land idle under green-manure.

Definition.—Compost is the product obtained by the rotting of organic waste materials, chiefly vegetable in origin, by the action of fungi and bacteria, with the ultimate formation of humus.

The Origin of Compost.—The employment of compost in agriculture is no new thing, since a method for its manufacture from animal droppings and various crop wastes is described by Ibn-el-Awam in his book on Nabathean Agriculture written in the 6th century.

Marcus Cato, 234-149 B.C., relates the Roman practice in composting farm wastes, and urges the farmers, on farms unable to support livestock, to collect all the crop wastes, leaves and weeds from hedgerows, ferns and sweepings, and mix all these with sewage and straw in a pit.

From ancient times, too, the fertility of the soil in China has been maintained at a high level by the use of compost made from animal and vegetable wastes, or green crops, fermented in layers with mud from the canals and rivers. Every scrap of organic waste is preserved for this purpose. Nothing is wasted.

The research of Hutchinson and Richards demonstrated that crop wastes could be composted with only inorganic sources of extra nitrogen, and this resulted in the placing on the market of the Adco process. The obstacles to this process being generally adopted in Rhodesia have proved to be (1) the necessity for an artificial water supply, (2) the necessity for using materials which are not obtainable on the farm and are rather costly.

Sir Albert Howard, and his co-workers, at Indore, later worked out and introduced a method of composting crop

wastes in a reasonably short time (three months), and without the need to purchase any materials from off the farm.

The modifications and improvements on this method worked out by Jackson, Wad and Panse, which simplified the making of compost from crop wastes with the use of rain only as the source of moisture, and which introduced the ingenious method of providing additional nitrogen supplies by growing a legume on the heaps, resulted in a simplified process, which fits in admirably with the requirements of Rhodesian agriculture. This process, with some modifications by the writer to suit local conditions, was published in the February, 1936, issue of this Journal.

Since then many farmers all over the Colony have adopted it, and increasing interest in it is being evinced. The writer considers that it presents a solution, or partial solution to several important problems of Rhodesian agriculture, and this aspect of the matter will be discussed later in this article.

SECTION 1.—TECHNIQUE OF COMPOSTING.

A. RAIN-WATERED COMPOST.—Detailed technique.

Materials Required.—(1) *Vegetable matter of any kind*, such as maize trash of all kinds, including the cores; dry or green grass; spoilt hay or silage; stalks of sunflowers, cotton and sunn-hemp after threshing; wheat, barley and oat straw and chaff; leaves of trees, including gums and scrub bush; saw-dust, waste paper and rags in limited quantities; the top-growth of the sunn-hemp crop. All green materials should be withered before use for a day or two.

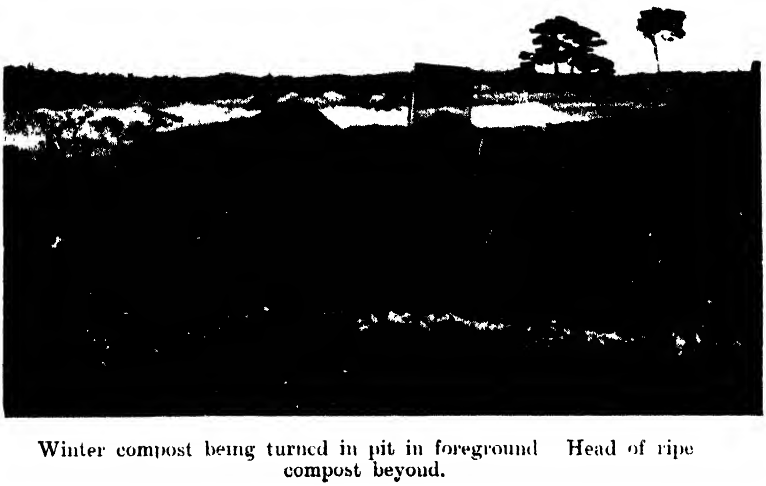
(2) *Dung* of cattle, horses, sheep, goats, pigs and poultry.

(3) *Ordinary field soil*—top seven inches only. Where soil soaked in urine is obtainable this is to be preferred, since it contains much nitrogen. It can be collected from cattle kraals, collecting yards, cow byres, etc.

(4) *Wood ashes or agricultural lime*—Wood ashes should be used for preference as they contain potash and phosphate as well as lime.

Proportions of Materials Required.—The above materials will be required in the following proportions:—

Type of pit for making winter or irrigated compost Sump shown in foreground not necessary.



Winter compost being turned in pit in foreground Head of ripe compost beyond.

Parts by volume.	Materials	Parts by weight.	Grain bags full per 9 yds length of a standard size heap.
120	Mixed vegetable wastes, etc.	400	
*36 to 18 or less.	Ordinary soil (urinated if available).	*560 to 280 or less.	*12 to 6
24	Animal dung.	80	8
*3 to 6	Wood ashes.	*6 to 12	*1 to 3
or 1 to 2	Agricultural lime.	*or* 2 to 4	$\frac{1}{3}$ to $\frac{2}{3}$
or $\frac{1}{3}$ to $\frac{2}{3}$	Burnt lime.	*or* 1 to 2	.

* For explanation of variation of proportions see Section II. under " Varying Proportions of Ash and Soil.

It is not necessary to measure the quantities of the various materials for every heap. It is considered that if the quantities are measured for the first few heaps made, thereafter the quantities can be sufficiently accurately judged by eye.

To assist rapid rotting the mixed wastes should consist of at least 25 per cent. of wastes with a high nitrogen content as specified in the list given in Section II.

Method. A well drained site should be selected, with a reasonably smooth surface, to avoid water-logging and to make turning easy.

Making the Heaps.—Having assembled all the materials required, the mixed wastes should be made into a heap 16 feet broad and $1\frac{1}{2}$ feet high, and of any convenient length. The heap should be built up in *at least* three layers to ensure even mixing of all the materials at the first turn, as far as possible. *More and thinner layers will assist proper mixing of the materials.* A shallow heap such as this facilitates rapid wetting of the materials with the first rains, and therefore a quick start to the process of rotting, and also makes the first turn easier.

The proper proportion of the soil, dung, and wood ashes or lime are spread evenly over the surface of each layer.

The materials should normally be collected during the dry season, and the heaps should be ready and awaiting the first spring rains.

First Turn.—After the first heavy rains have partly wetted the heap, usually after about 2 to 3 inches of rain have fallen, the heap should be built up into a new heap 9 feet broad at the base by 3 to 3½ feet in height, by throwing the materials with a fork in towards the centre line from either side, and two yards forward at the same time. In doing this mix all the materials thoroughly. *The heap should be left in a loose open condition to assist aeration, and the easy entry of further rain. On no account should the heaps be packed by trampling at any time.*

If the heaps are composed of fine materials such as grass, spoilt hay, maize husks, etc., the rain will not penetrate the heap to a depth of more than about 6 inches, since at this depth a slimy waterproof film is formed by the action of certain microbes.

Second Turn.—In three to four weeks, when the heaps have sunk and packed appreciably, they should be turned to one side or one end, and built up into new heaps of the same dimensions. If rotting has proceeded well, labour may be economised at this and subsequent turns by the use of a dam-scraper, or hay sweep, or similar ox-drawn implement. If rotting is unsatisfactory the use of sharpened "badzas" will help to ease the work.

Manure drag forks, or vine hoes, which are 4 or 5 tined, are of particular value, where very refractory materials such as old matted sunnhemp stalks have to be turned. With these the most obstinate heaps can be torn open; but they will seldom be required after the first turn has been carried out.

Third Turn.—The heaps will require turning again in about a month as before, and will be rebuilt in their original position, and rotting should be complete in a further three weeks to one month. If rotting has not proceeded normally a further one or two turns may be necessary.

The various turnings are done to ensure aeration, and even distribution of moisture or materials, and they should

usually be done on a rainy or cloudy day to check evaporation, unless the heaps are waterlogged. The compost is usually rotted down and ready for use in four months. If it is ready before the end of the rains it is best to delay spreading it on the fields for ploughing under until the seasonal rains have ended, so as to avoid loss, and it should be covered as soon as it is spread for the same reason.

On the other hand, if there is a special reason for using it as early as possible, and providing rotting has proceeded normally, the compost can be applied to the land at the third turn.

Sowing Legumes on the Heaps.—When the wastes being composted are mainly of low nitrogen content, such as old dry grass and maize wastes, or if it is desirable to speed up the rotting process as far as possible, sunnhemp should be broadcast on the surface of the heap after the first turn. The writer has found that the common sunn-hemp makes better growth under these conditions than the Somerset variety, and two or three pounds of seed per 100 square yards of surface may be used. It is not necessary to add a surface of soil to enable the sunnhemp to grow, but a thin sprinkling of top soil will help to ensure proper inoculation of its roots.

The sunnhemp will only grow some 6 to 12 inches high before the next turn, but the roots penetrate the heap and the bacteria in the nodules on the roots collect nitrogen from the air. When the sunnhemp is turned under at the next turn this nitrogen promotes rapid rotting, and enriches the compost.

In some cases the writer has seen the sunnhemp being allowed to grow to a height of two or three feet. This is a sign that turning has been unduly delayed, and that the proper heating in the heaps had ceased. It also makes the subsequent turning of the heap very difficult.

Velvet beans are also of value for this purpose, and where compost is being made in winter lupins may be employed.

B. ARTIFICIALLY-WATERED, OR WINTER COMPOST.

When a supply of water is available compost can be made throughout our rain-less winter. It should be made in shallow pits in order to protect it from the drying winds, and to help maintain the temperature of the heaps.

Size of Pits.

Depth—2 feet—never deeper.

Width—15 feet.

Length—any convenient; but a 60 to 65 feet long pit is suitable, and contains about 25 tons, or 50 cubic yards, of moist ripe compost. The sides and ends of the pits should be cut with a slope at an angle of 45 degrees. (See illustration.)

Filling the Pits.—The same materials and the same proportions of them are required as for rain-watered compost. Fill these into the pits in shallow layers, say, 6 inches deep. The shallower the layers the better will all the materials be mixed at the first turn, and the more rapidly will rotting commence, and the more smoothly and evenly proceed.

Fill the pits to a height of 6 inches above ground level. Leave 8 feet at one end of the pit empty for turning.

Watering.—Each layer may be watered as it is filled in. It should be well wetted, but not drowned in water.

Turning.—As soon as the pit is full, turn the materials, and shake them up, and mix them thoroughly. Sharpened badzas and drag forks will be found useful at this stage. Turn from the end where the empty space has been left, and move the whole heap 8 feet, so that 8 feet of empty space is left again at the opposite end, for the next turn.

Second Turn.—Three weeks later, water the heap and turn again.

Third Turn.—A month later, water and turn again. If necessary a further turn should be given.

A month later empty the pits and stack the compost at the side in heaps 9 feet broad by 4 feet high, to mature for

a further month. It can be carted to the fields and ploughed in at this stage if desired.

At each turn after the first the amount of water required is much less than before the first turn, and care should be taken not to use too much. The heap should be just moist all through, but not "sopping wet." Excess of water will prevent proper aeration, and rotting may stop in extreme cases.

If there is any urgent need to hasten the process, then the heap can be turned every 10 days or two weeks, and more dung added; or, if this is lacking, sulphate of ammonia may be used at the rate of ½ lb. to 1 lb. per cubic yard of the heap, or bone-meal at the rate of 2-4 lbs. per cubic yard; preferably the latter.

If the pits are watered from a water furrow, care should be taken that they are not near enough to the furrow to become water-logged by seepage from the furrow.

C. KRAAL COMPOST.

The chief item in the cost of making compost from the crop wastes on the farm is the collection and carting of the materials to the composting sites. The means of transport available on Rhodesian farms for this work, that is the ox wagon and Scotch cart, are extremely clumsy, inefficient, and unsuitable for the work. They are also very wasteful of ox-labour for pulling them, and of human labour in filling and emptying them. They are, in addition, very costly. Furthermore, the work of collection and carting of the materials for composting will compete for the use of the wagons with essential work such as the transport of the maize crop to the railway.

For the above reasons it is clearly desirable under local conditions to cut down as far as possible the collection and transport of the crop wastes for composting, and with this in view the following modified technique for treating the large quantities of maize wastes at the shelling dumps, and wheat wastes at the threshing sites, is advised.

Up to date many farmers have been in the habit of destroying this most valuable organic matter by burning. In the case of maize wastes this has been rightly done in the past in order to check the spread of diplodia and allied diseases, and also of weevils, because it is considered by competent authority that they may not be destroyed if converted into kraal manure, owing to the low temperatures which obtain in the manure heap. There is now no excuse for this criminal waste of the material most urgently required in our Rhodesian soils, namely, organic matter, since these wastes can be converted safely, cheaply, and easily without any artificial water supply, and without the need to use anything that is not to be found on every farm, into first-class humus, by composting them.

Technique.—The modified technique of composting advised for treating maize and wheat wastes at the dump is very simple, and is given below. It is followed by a more detailed explanation of certain points.

(1) Erect a cattle kraal at the shelling or threshing sites.

(2) Place the maize husks and cores, or the wheat and barley straw, in the kraal to the depth of about two feet

(3) Keep cattle in the kraals until sufficient dung and urine has been dropped by them, and until the depth of trampled wastes in the kraal is about 18 inches. Fill the wastes into the kraal daily as the cattle eat and tramp them down.

(4) Divide the trampled mass in the kraal into heaps 16 feet wide, and over every 9 yards length of the heaps spread one or two bags of wood ash (or a third of this quantity of agricultural lime), and six bags of top soil.

(5) Fork over the heaps well, working from one end, and mixing all materials together. Take care to mix the saturated materials from the bottom with those on the top.

(6) After about three inches of rain have fallen in October or November, build the heaps up into new heaps 9 feet wide by $3\frac{1}{2}$ feet high by forking from the sides in towards the centre line.

(7) Turn the heaps once a month, on rainy days if possible (except during heavy continuous rainy spells) until the end of the rains, when the compost should be ripe and ready for carting to the fields and ploughing under.

It will be clear from the above description that the method is extremely simple, and eliminates practically all transport of materials, except the small quantity of wood ash required.

It will be most convenient for the subsequent handling of the compost if the kraal is made 16 feet, 32 feet, or some other multiple of 16 feet wide, since the trampled mass of wastes and dung has later to be split up into heaps 16 feet in width.

If the kraals are made with a large enough gate at each end the straw or maize husks can be drawn into the kraal by a hay sweep, and hand labour thereby savd.

It is thought that it will be best to erect a temporary kraal each winter, since after it is filled it can be quickly removed, and will then not interfere with the subsequent work in which hand labour can be saved by using dam scrapers, ploughs, hay sweeps or similar ox-drawn implements for assisting in turning the heaps.

The maize cores should be thinly spread over the surface daily, so that they will be well distributed through the mass. These may not completely rot down in the compost heap, but will become so soft that they will rapidly break down in the soil. Where hand shelling is done it will be best to burn the mouldy cobs, since these will add little bulk to the compost, and their destruction will help to prevent the spread of disease.

The maize stalks and any other handy vegetable wastes form neighbouring fields can be conveniently placed in the kraal in thin layers daily. A generous layer of at least 12 to 18 inches depth should be placed in the kraal to start with, so that the urine may be absorbed and saved from loss as far as possible, since this is a most valuable by-product from the cattle because of its high nitrogen and potash content, because of the hormones it contains.

It is not possible at this stage to state what length of time the cattle must be kept on the wastes. This can only be found out by experience, but it is obviously desirable to discover the minimum so that there shall be no large losses of nitrogen owing to the surplus of dung and urine. Such a surplus of dung and urine could be profitably employed elsewhere as agents for breaking down additional organic matter to humus. If the latter is not available then there is no objection to keeping the cattle rather longer in the kraal than is strictly necessary, and it will assist in speeding up the rotting of the compost, and the maintenance of a high temperature.

The first turn of the heaps laid down above is designed to prevent the loss of nitrogen through the denitrification which would otherwise take place owing to the compacting of the bottom layer of wastes and dung. Denitrification is brought about by the action of certain types of organisms, which chiefly work in the absence of air, and this condition is brought about by the compacting of a heap by the trampling of the cattle. During the process nitrogen is lost in various gaseous forms: as ammonia, oxides of nitrogen, and nitrogen itself. In this and in all subsequent turns care should be taken to leave the heaps as open and loose as possible, and any compact portions should be broken up with the fork. Always in turning put the outer and less rotted layers inside the heap, and *vice versa*.

At the first turn manure drags or vine hoes will be particularly useful for tearing the heap apart.

Destruction of Weevils and Diseases.—This is particularly important in the case of maize wastes in order that weevils and the spores of diseases such as those of the diplodia group shall be killed by the temperature of the interior of the heap. For the same reasons in treating maize wastes, if necessary, more frequent turns may be given to ensure the development of a high temperature in the heap.

The soil added to the heaps, too, should be taken from the immediate area of the shelling dump, so that weevils in the grain tramped into the surface may also be killed.

In composting maize wastes the heaps should always be in readiness awaiting the commencement of the seasonal rains in October, so that weevils may be killed as soon as posible.

Comparison with Indore Composting.— It will be clear that in the modified technique described above that the quantity of nitrogen supplied in the dung and urine of the cattle cannot be so well regulated so as to avoid waste as in the normal methods developed at Indore. A certain amount of waste may take place owing to the use of more dung and urine than is necessary and also because some losses of nitrogen by denitrification whilst the cattle are in the kraal will probably take place owing to the compaction of the lower layers of wastes.

However, this will be a matter of less importance where the farmer has insufficient supplies of organic materials (crop wastes, sunnhemp, grass. etc.) for converting into compost. Furthermore, experience will soon teach the farmer to reduce these losses to a minimum by finding the minimum time necessary for keeping the cattle in the kraal

It will probably be found in practice that the amount of dung and urine supplied by the cattle can be reduced below the minimum necessary for rapid rotting of the compost, without unduly slowing down the process. This will automatically reduce the losses of nitrogen to a minimum and should even lead to appreciable gains of nitrogen from the air, by nitrogen fixation.

One considerable advantage this method will have in this Colony over the ordinary Indore composting is that the urine will be more fully and more economically employed, since urinated soil is not available on most Rhodesian farms in sufficient quantities, and the urine is usually almost entirely lost. This better utilisation of the urine is of considerable importance, since it contains much nitrogen and potash and important hormones.

The greatest advantages claimed for the modification are, however, that both ox labour and human labour are saved and it is considered that these economies will more than outweigh the possible losses.

(To be continued.)

Cleanliness Aids Insect Control.

Farming Calendar.

OCTOBER.

FORESTRY.

The main sowings of eucalypt seeds should be made either in seed trays or in well prepared seed beds. A well-broken soil forming a fine tilth in the seed bed ensures more successful germination and better plants. If transplants are being used, any seedlings which are ready should be pricked out.

Seedlings in open beds may have their tap roots cut so as to develope fibrous lateral roots, and thus produce good type stocky plants. Remember the plant feeds through its roots, hence the better root system the healthier the plant and the greater its chances of successful establishment. If conditions are favourable, cross-plough and harrow land for planting broken up in early autumn. Continue to guard against fires.

CROPS.

Prepare your compost heaps for the rains. If not already attended to, overhaul all farming implements and replace worn parts to ensure efficiency. Shell ground nuts required for the season's planting. Ploughing of old lands should at latest, be finished this month. If seed potatoes will not keep in good condition until next month, they may be planted now, but they must be planted deep. Edible canna may be planted this month before rain falls. Also velvet beans, dolichos beans and sunnhemp towards the end of the month for green manuring. Harvest winter cereals and plough under the stubbles as soon as possible after harvest. When rains have fallen, use every effort to improve the tilth of the lands which will be the first to be planted. On cloddy lands already ploughed, seize the opportunity to break down the clods by disc and drag harrowing as showers of rain fall.

A spiked roller is very useful for this work. A good tilth means good planting, and a good stand of maize.

When necessary, keep the harrows going to check early weed growth. Clean lands at this time of year are an insurance against cutworm and other insect pests. If weather conditions permit, plant a trap crop of maize to attract the stalk borer. New land to be ploughed and intended for planting this season should be cleared of heavy grass or weeds by burning or cutting to ensure good work being done by the ploughs. Seasonal showers of rain are liable to spoil bricks unburned. See that bricks which have been made are protected from rain. Clean out guttering and down-spouts of house and farm buildings. Press on with development work so as to have this completed before rains break.

STOCK.

Cattle.—Ranching cattle on granite veld will in many instances be in fairly good condition on account of the early grass in the vleis, etc. On the diorite soils and later veld the cattle owner will still have to watch his weaker cattle carefully. In any case all supplies of hay, ensilage, majordas, etc., should be carefully husbanded in anticipation of possible late rains, but at the same time every effort should be made to prevent cattle becoming weak.

During the month of October and until such time as the rains have commenced and green grazing is available, dairy stocks require to be almost entirely stall fed. Cows in milk and cows due to calve should be liberally fed on succulents and concentrates in order that they may commence the dairying season in good condition, and make full use of the early grazing for milk production. Dairy cows that are underfed at this time of the year invariably produce milk of poor quality, and usually throw weedy, undersized calves; furthermore, they do not pick up in condition until comparatively late in the season.

During October, the cow's ration should consist of succulents such as silage or green feed, etc., legume hay of

good quality and a liberal allowance of concentrates; a pound or so of a feed such as ground-nut cake is invaluable for dairy stock at this time of the year.

Sheep.—The rams should be put in now to ensure March and April lambs. Good green grass or a bit of supplementary feeding will flush the ewes and ensure a bigger crop of lambs. Keep the rams in during the day and feed them. Continue dosing the weaners well. Commence dosing very regularly, and in the more moist areas keep all sheep out of the vleis.

DAIRYING.

Weather conditions are generally fairly warm during the month of October, and every precaution should be taken to keep the cream, which is used for butter-making or which is sent to the creamery, as cool as possible. The can or bucket containing the cream should be placed in a basin of water or concrete trough, in the dairy, and exposed to a draught; a piece of kaffir blanket, which dips in to the water, should be wrapped around the can or bucket containing the cream. Churning of cream for butter-making is best carried out early in the morning—before sunrise if possible; the coolest water obtainable should be used for washing the butter whilst in the granular stage.

At this season of the year cheese-makers may find that the milk is deficient in butter fat; this is generally the result of under-feeding or unsuitable feeding. Cheese made from milk of low fat content is invariably dry and hard, defects that are accentuated by over-cooking the curd or by cooking at too high a temperature. The curd should be firmed in the whey at a temperature not higher than 98 to 100 degrees F.

VETERINARY.

OCTOBER—DECEMBER.

The first rains may be expected during this period, and due to heat and moisture tick life will become active and cases of redwater and gall-sickness and other tick-borne diseases may be expected. Occasional horse-sickness may occur during December. Vegetable poisoning may still be in evidence unless grazing becomes good.

FLOWER GARDEN.

All flower seeds, annual and perennial, may be sown as in September. A word or two on open seed beds may not be out of place here. These beds should be prepared in a sheltered position, and the soil should be well and deeply dug. This is most essential, as in this state the soil when once watered is more easily kept moist, and is not so liable to cake. The top dressing should be free from all undecayed vegetable matter, and when sown, the seeds should be covered with a thin dressing of fine, light soil, over which a thin covering of grass may be placed to check evaporation.

Transplanting from boxes or beds should be done on a dull day or towards evening; the plants should be well watered before being removed, and the roots disturbed as little as possible, care being taken that the latter have their full depth and spread when planting.

VEGETABLE GARDEN.

As in September, nearly all vegetable seeds may be sown. Early potatoes should be earthed up when reaching the height of about eight inches. In planting a small amount of marrow, melon, cucumber, and pumpkin, the writer has found it economical to sow the seed one in a tin and transplant when about four inches high in hills. A few cucumbers planted in this manner yielded nearly 400 a week for about two months. Sweet corn and maize may also be sown this month.

POULTRY.

October is usually a hot month, and poultry keepers should therefore see that their birds have access to shade during the day. At the same time they should have plenty of air. One often sees birds during hot weather sitting under dense bushes, which is almost worse than no shade at all.

All houses should be examined and, if necessary, repaired. It is advisable to repeat the caution that birds must have dry quarters.

Many poultry keepers do not realise the vital necessity of giving their birds, especially the young stock, plenty of succulent green food during the hot weather. It should be cut up and placed in boxes or hoppers about 7.30 a.m. and 5 p.m., and, if very hot, also at noon. It should never be placed in the sun. As much as the birds will eat should be supplied. Lack of it, especially during hot weather, causes a reduced output of eggs, smaller eggs and light-coloured yolks; further, a disease known as "nutritional disease" is likely to affect the birds and cause deaths. The symptoms are much like those of eye roup, without the well-known offensive smell of roup. It is due to the fact that vitamine A, which is present in large amounts in all succulent green foods, and which is so necessary for nutrition, is lacking. There is no doubt that many chickens and fowls die each year from this cause.

Ducks.—These during the hot weather require even more shade than do fowls; they cannot stand the direct rays of the sun nor sultry heat. The houses should always have dry floors, and should be overhauled before the rains commence. Ducks sleeping on damp floors often contract rheumatism and cramp. The floor of the duck house should be raised a few inches, thus ensuring a dry bed.

As many ducklings should be hatched as possible now, provided, of course, there is the prospect of a sale for them at ten weeks old. They thrive best in the wet weather.

Turkeys.—Stop hatching until after the wet season is over. To rear turkeys in the wet weather entails a good deal of time, labour, expense and often losses. Once a young turkey chick gets wet, it will probably die; at any rate, it will never be the same bird it would have been had it not got wet. Give the older turkeys all the range possible; the further afield they go, the better grown birds they become, and less is the expense of feeding. See also that their roosting quarters are water-tight before the rains commence.

Southern Rhodesia Veterinary Report.

AUGUST, 1939.

DISEASES.

African Coast Fever was diagnosed on the farm Highlands, Salisbury native district.

TUBERCULIN TEST.

Twenty-three bulls and 119 cows and heifers were tested on importation, and of these 10 cows and 1 bull reacted to the test. The cows were destroyed and the bull was returned to the Union of South Africa.

MALLEIN TEST.

Forty-six horses, 16 mules and 30 donkeys were tested on importation, with negative results. Three horses were tested on exportation and there were no re-actors.

IMPORTATIONS.

From the Union of South Africa: 40 bulls, 142 cows and heifers, 45 horses, 16 mules, 30 donkeys, 1,135 sheep and goats.

From Bechuanaland Protectorate: 553 sheep.

From the United Kingdom: 1 horse.

Eleven bulls and two heifers were imported from the Union of South Africa for Show purposes.

EXPORTATIONS.

To Union of South Africa: 517 oxen, 56 cows, 3 horses.

To Portuguese East Africa: 101 cattle, 42 sheep and goats, 6 mules, 8 donkeys.

To Northern Rhodesia: 2 bulls, 12 donkeys.

RE-EXPORTATIONS.

To Union of South Africa: 1 bull.

EXPORTATIONS—MISCELLANEOUS.

To United Kingdom: Chilled beef quarters, 5,995; frozen boneless beef quarters, 953; tongues, 9,744 lbs.; livers, 19,631 lbs.; hearts, 7,100 lbs.; tails, 10,330 lbs.; skirts, 3,895 lbs.; shanks, 5,421 lbs.

To Belgian Congo: Beef carcases, 132; mutton carcases, 22; sheep plucks, 12; brains, 56½; sweetbreads, 36.

To Northern Rhodesia: Mutton carcases, 24; pork carcases, 10.

Meat Products from Liebig's Factory.

To Union of South Africa: Corned beef, 37,416 lbs.

To Basutoland: Corned beef, 480 lbs.

B. A. Myhill,
Chief Veterinary Surgeon.

NOTICE

The Agricultural Journal of S. Rhodesia

is issued by the Department of Agriculture, and can be obtained upon application to the Editor. The Annual Subscription, which must be paid in advance, is 5/-, and payment may be made by any means other than by stamps.

A 10/- note will cover the subscription for two years.

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If payment is made by a cheque drawn on a bank outside Rhodesia, commission must be added.

All cheques and postal notes must be made payable to the Secretary for Agriculture and Lands.

Date..........................19.....

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Editorial.

Contributions and correspondence regarding subjects affecting the farming industry of Southern Rhodesia are invited. All communications should be addressed to:—The Editor, Department of Agriculture, Salisbury. Correspondence regarding advertisements should be addressed:—The Art Printing Works, Ltd., Box 431, Salisbury.

The Producers' Dilemma.—The following appeared in the *Farmers' Weekly* of October 18th: "How and in what way the farmer can cater to the needs of the situation created by war on a large scale, so as not only to serve the interests of the State, but in order to reap some return which he stands so sorely in need of, is a question that is anxiously occupying the thoughts of the farming community at large. The question would be easily answered if the precedent and experience of twenty-five years ago could be accepted as a safe and sure guide—all that would have to be done would be to follow the slogan: Produce, produce, to the utmost extent of one's capacity and resources. That slogan was applicable and safe enough in those days when the limited range of crops culti-

vated in the Union was what the world was in most need of. A severe drought and a rebellious eruption prevented much advantage being taken of the situation in the early stages of the war, but in the end expectations were fulfilled. Export prices for maize rose to such a level as to cause alarm to stock raisers, who agitated for the prohibition of any further exports. The general effect of these high prices, under the impression that they would be maintained, was to stimulate production on every hand, to send up land values and to encourage a widespread campaign of farm improvement.

Another and more lasting effect of that war was the establishment of secondary industries, which to-day have assumed such large and varied forms and which have contributed so largely to the self-sufficiency of the country. With these experiences in mind it is assumed that the present war will again serve as a stimulant to both the primary and secondary industries. As regards the latter, optimistic hopes may be justified, and in that event will serve to widen our local markets for primary produce; but whether this market plus an extra demand from overseas for our produce will justify a strenuous programme of primary production is another matter. Because of what happened during the last war we find it urged in some quarters that farmers should not only extend production of their staple crops, but should once more take up the cultivation of cotton and other crops of which there is likely to be a shortage; even the Angora rabbit is in the limelight again. But the trouble is that the effects of the stimulus to agricultural production given by the last war in all the great crop producing countries remains in the shape of surpluses of food and other stocks sufficient to provide for the needs of the world for months to come.

The United States has a huge accumulation of maize and cotton on hand on which Government advances have been made and which it has been unable to dispose of without enormous loss to the Treasury, a position rendered still worse by bounteous harvests in sight. The same holds good in regard to wheat. Under these circumstances it would be unwise for the farmer to embark on any unrestricted programme of production that would involve an expenditure beyond his present means. Rather should he devote his

energies to carrying out his normal programme in the most efficient and economical manner possible; and it is here where the man who practices mixed farming is most likely to reap the reward of his labours."

Cleanliness in November.—Stalk borer damage can be considerably reduced if the last of the old maize stalks are destroyed well before the end of November. The first moths may usually be expected to appear before the end of the month.

If shelling dumps are not to be left to act as a source of field infestation by maize weevil, they should receive early attention. Most of them should by now have been taken care of. Those that are to be composted should be tackled as soon as there has been sufficient rain, unless the work can be done before that. Those that are to be burned should be spread out and burned at once to obtain a good soil-penetrating fire.

Pests of fruit and cucurbits can be prevented from increasing by removing and destroying all windfalls and infested fruits regularly. Immature forms that are in citrus fruits now normally transform to adults which infest other susceptible fruits that are ripening.—Cleanliness Aids Insect Control.

Be Persuaded.—Over forty years ago Dr. S. A. Forbes, internationally known economic entomologist and naturalist, and former cavalry captain in the American Civil War, who died in 1930, wrote the following: "It is not the facts of entomology that we discover, but those we persuade the farmer, the gardener or the fruit grower to use diligently for the protection or the preservation of his crops, which make our entomology economic."

Let us, therefore, remind the farmer, the gardener and the fruit grower of the fact of entomology that *Cleanliness Aids Insect Control.* By following a policy of agricultural hygiene, these men can help to make an economic proposition not only of entomology *but also of agriculture.*

The Conditions Governing the Hire of Government Boring Machines.

By Major C. E. GOAD, M.C., Boring Superintendent.

The conditions under which farmers and other private applicants may obtain the services of the Government drilling machines for the purpose of boring for water are defined in the Water Act, 1927, as amended by the Water Amendment Act, 1938. Regulations for the Hire of Government Drills for Water Boring, etc., are published in Government Notice No. 458 of the 29th September, 1939.

Copies of these regulations are obtainable on application to the Director of Irrigation, P.O. Box 387, Salisbury, or the Irrigation Engineer, P.O. Box 566, Bulawayo.

The following fuller details regarding certain sections of these regulations are published for general information. Applicants in the past have sometimes complained that regulations of this nature are not sufficiently self-explanatory and that they do not know what their commitments are likely to be if the services of one of these machines is obtained.

Charges involved (Section 21).—Charges for the drill are on a daily and not footage basis, a day being reckoned as a 9½ hour working period. The cost involved in hiring one of the machines comprise:—

(*a*) A charge of £3 per day whilst the drill is being set up or dismantled and for carrying out a pumping test (12 hours or under).

(*b*) A charge of £6 per day whilst actually boring or while essential operations in connection therewith are in progress. This includes inserting, withdrawing or perforating casing and dressing of bits.

(*c*) A charge of £5 per day for any delays due to the applicant not supplying fuel, water or transport.

(*d*) The cost of casing put down to line the borehole; the cost of casing varies according to prices prevailing at the time, but may be taken to range from 3s. 10d. per foot for 5 inch, 4s. 6d. per foot for 6 inch, and 11s. 6d per foot for 8 inch diameter casing.

(*e*) Where one borehole only is drilled on one application, an applicant will be charged a minimum sum of £50 in respect of such charges as are detailed under sections (*a*), (*b*) and (*c*) of Section 21.

(*f*) A charge of 10s. per day is made in the case of drills driven by internal combustion engines. In the case of a drill equipped with a tractor a charge of 10s. per mile will be made to move the drill to the applicant's site.

Average Costs.—The list of charges detailed above appears formidable, but in actual fact the boring costs do not, on the average, amount to a considerable sum, and are cheaper than sinking wells to a corresponding depth in similar formation. The only cases in which complaints are received as to the high cost of boring are those where more than one borehole has had to be sunk on a property before a supply is obtained.

The total footage drilled for private applicants since drills have been powered with crude oil engines has amounted to 18,814 feet, at an average cost of 14s. 10d. per foot, including the price of casing supplied, but excluding fuel, water and transport. This footage represents 148 boreholes which have been sunk for private applicants, of which 85 per cent. have yielded useful supplies of more than 2,500 gallons per day at an average depth of 125 feet.

From this it will be seen that the total cost per borehole is under £95, and it will be admitted that if all boreholes could be guaranteed to be sunk for this figure, there would be no cause for complaint. Unfortunately, however, there can be no guarantee of this nature as the costs vary considerably in different formations, and during the period in question

the costs for individual successful boreholes have varied from 7s. 7d. per foot to 34s. 4d. in extreme cases. In the majority of cases it is safe to assume that the cost per borehole will not exceed £150, including costs of fuel and transport.

Method of Payment (Section 3).—There are six methods by which payment of the boring charges may be made, *viz.*:

(*a*) By payment of a cash deposit of £75 and such additional sums as may become due during the progress of operations.

(*b*) By payment on demand of the full amount after completion of the work. Security required being two personal sureties who are holders of immovable property in Southern Rhodesia.

(*c*) By payment of monthly instalments over a period not exceeding two years. An interest charge at the rate of 5 per cent. per annum on any outstanding instalments from due date to date of payment and any balance outstanding at the expiration of such period until the amount due is paid in full. Security as in (*b*) is required.

(*d*) By payment of a cash sum on completion of the boring operations and the balance by instalments under same conditions as (*c*).

(*e*) By an advance from the Land Bank. In these cases applicants have to submit a certificate from the Manager of the Land Bank stating the amount of the advance that has been approved.

(*f*) By an advance from Irrigation Loan Funds (applicable only to farmers). An applicant who wishes to take advantage of these facilities should make application on a separate form for a loan to cover the estimated cost of the boring charges, the necessary forms being obtainable from the Irrigation Department.

These loans are granted normally subject to 4½ per cent. per annum interest charges and are repayable in annual instalments, the period of redemption varying from 5 to 10

years, dependent on the amount of the loan. The first annual instalment is usually called for about a year after the completion of the work.

The security required for an irrigation loan is either two personal sureties who are holders of immovable property in Southern Rhodesia, or failing that, the loan will be registered against the title deeds of the farm at no extra expense to the applicant.

All applications for irrigation loans have to be approved by the Governor-in-Council.

Classes of Government Drills. (Section 13).—The standard equipment at present supplied consists of combination drills, the percussion or jumper portion for boring through soft formation and the rotary shot equipment for boring through hard rock. Either type may be brought into operation as required. All drills in present use are driven by internal combustion engines. There are three types of drills. Single unit, double unit and double unit with tractor.

The Director of Irrigation reserves the right to send whichever type of drill is the most convenient.

Transport (Section 15).—The single unit require one span of 14, and 1 span of 8 oxen and two wagons with full teams of oxen to move the drill, caravan and equipment.

The double unit as above, but with extra team of 14 oxen.

Double unit with tractor. The applicant will not be called upon to supply transport, but a charge of 10s. per mile will be made.

If the applicant can supply motor transport consisting of not less than a 3-ton lorry fitted with tow hitch, short moves can be carried out in a reasonable time, but for moves covering a distance of more than 8 miles would require not less than one 3-ton and one 5-ton lorry, providing the roads and gradients are reasonably good. Drills and caravan are mounted on pneumatic tyres.

Speed of travel by motor vehicles is not to exceed 8 miles per hour.

Fuel and Water.—Sufficient fuel and pure drinking water is to be supplied by the applicant for the use of the drill foreman and native staff, as well as wood fuel or coal for dressing bits.

During boring operations a quantity of water is required to operate the drill, approximately 350 gallons per diem for percussion drilling and up to 1,600 gallons per diem for shot drilling. Practically any quality of water can be used for this purpose, providing it does not contain too much mud or silt. The plant is provided with square tanks of 200 gallons capacity, which can be conveniently carried on a wagon or lorry for conveyance of water from source of supply to the drill.

Geophysical Prospecting and Rebates.—Application for the hire of a Government drill must be accompanied by an application for geophysical prospecting together with a cheque for £2 2s. (made payable to the Accountant, Division of Agriculture and Lands), and Schedule A completed. In the event of boring being undertaken on the site selected the deposit will be deducted from the boring account. A site selected by this means assures the applicant that, in the event of a supply not being developed, his application for a rebate will be recommended. If no favourable site is selected and the applicant still wishes to bore he must sign a form agreeing not to apply for a rebate.

In cases where boring operations have been carried out in terms of these regulations (458 of 29th September, 1939), on a site approved by the Director of Irrigation and which have been unsuccessful in the developing of a water supply, an application for a rebate of the actual charges under section (21) paragraphs (*a*) and (*b*) up to a maximum of 75 per cent. of such charges will be considered. Applications for rebates should be made upon receipt of the account showing boring charges.

No rebate will be considered if a yield of 50 gallons per hour has been developed on an urban residential plot or industrial stand.

Rebates would be recommended for farmers, providing the applicant does not limit the area on which the site might be selected and supplies developed yield less than 200 gallons per hour.

No rebate will be considered if the applicant wishes to bore in the bottom of a well, and all applicants are advised against this practice.

General.—An application for the hire of a drill and geophysical survey must be made on the prescribed forms.

Since the charges are based on a daily rate it is in the applicant's own interest to render all assistance possible for the expeditious carrying on of the operations.

The drill foremen are instructed to submit their weekly reports to the applicant for signature before forwarding them to the Irrigation Division, and applicants are advised to satisfy themselves that the information contained therein is correct. No discussion as to their accuracy can afterwards be considered.

Sports Item.

The winner in the Farmers' Handicap is Insect Control out of Cleanliness.

Forking-up Tobacco Seedlings.

By R. G. Gossip, Acton Farm, Eldorado.

A writer of an American pamphlet on Root-Rot of Tobacco(1) gives an instance of a farmer who pulled from his beds sufficient plants to set half an acre, but finding them so badly diseased that the root systems were largely rotted off, he decided not to plant them and put them in a cellar instead. After three or four days the plants developed new roots, and they were set in one corner of a field of quite light, sandy loam. "At the end of the season," the writer goes on to say, "no appreciable difference could be noted in either vigour, yield or quality." (With the remainder of the field, which had been planted with healthy plants.)

When I read this, some years ago, I wondered if similar treatment would not give similar results in the case of eelworm. As it would not be possible to foretell the weather, so as to have plants pulled from the beds several days in advance of a good planting out spell, some other method of giving the seedlings a secondary root system had to be sought. In the end I decided on forking-up the beds. I bought a five-pronged digging fork, and choosing the evening of a dull, cool day, I forked-up a bed or two. The next morning the plants had wilted and looked very sorry for themselves, but I kept them well watered, and scattered grass over them to help keep them cool. About a week or ten days elapsed before the rains came, and during this period the plants picked up, and except for a great many sun-scorched leaves, looked very healthy. At the same time they did not put on any (or at any rate very little) more growth, but appeared to use up their energies in forming a complete secondary root system. When a suitable planting day came and I pulled them from the beds, they came away very easily, bringing a lot of soil with them, and at the same time they had a tremendous

(1) The Root-Rot of Tobacco caused by Thielavia Basicola. By W. W. Gilbert, U.S.A. Department of Agriculture.

system of fine, fiberous roots. On planting in the land they took hold quickly, and grew up without a check into strong plants.

In order to test efficiently the degree of resistance—if any—of these plants to eelworm attack I, last year, gave Mr. Hovy, of the Tobacco Research Station, Trelawney, about five hundred of them, which he planted into nematode infested land. During the growing season he reported that they showed great promise, but after curing he found that they gave no appreciable improvement over the controls.

However, it is not as a presumably inefficient remedy for eelworm that I am writing to the Journal. It is to make a suggestion to those growers who have plants ready before the rains come. In the normal course these plants would be dug up and thrown away, but if the grower fears a shortage of seedlings, he might try forking them up, and so delay throwing them away for at least a week or two. The forking up breaks the majority of the roots, and has the same effect as the Forestry Department get when they cut under the roots of their gum tree seedlings.

In any case, many farmers must have often wondered why we always pull our little plants from the beds. If we are planting out gums, or cabbages, or zinnias we ease them from the ground with a trowel or something. Why not fork up our beds just prior to drawing the plants from them? It must certainly give the seedlings a better chance of living when they go out into the land, and as we are advised by Trelawney(²) not to re-pick over tobacco beds where possible, it would not matter what happened to the plants remaining unpicked. In any case, the forking taking place on a dull day and after rain, they could come to no harm.

(²) Practical Methods for the control of Tobacco Mosaic. By I. P. Norval, Tobacco Research Station, Trelawney.

Farming Calendar.

NOVEMBER.

FORESTRY.

The sowing of eucalypt seeds should be completed by the middle of this month. If fresh seed of cedrella toona is available, sowings should be made. Keep the seed beds moist and free from weeds. The tap roots of early seedlings may be cut back in order to form hardy, stocky plants most suited for planting. Continue with pricking out if transplants are to be used. Prepare all land to be planted by cross-ploughing and harrowing. A well prepared soil is a good fertiliser; it assists establishment and reduces failures. Fires are still a menace, and all fireguards should be kept in order.

CROPS.

Have you a reserve of seed maize for replanting? Take note when the first rains fall, and see what leaks there are, if any, in the farm buildings. Do not neglect to effect such repairs as are necessary. Early in the month see that the planters are in perfect order, and that they drop the different seeds to be planted evenly and at the right distance. Try them out on the farm road. Hasten the work of getting the lands for early sown crops into as good a condition for seeding as possible, so that the first and most favourable opportunity for planting may be seized. The young plants make more rapid growth in a good seed bed. Utilise exceptionally early rains for this purpose rather than for planting. The holes for check-row planting of maize can continue to be prepared until sufficient rain has fallen to allow of planting. Velvet beans and dolichos beans for seed or hay may be planted dry if the land is in good order. With favourable weather planting of maize, velvet and dolichos beans will commence about the middle of the month, and will continue as the

condition of the land and the rainfall permit. Main crop potatoes should be planted for now on to January. Dhal may be planted for seed or green manuring—if for seed, a frost free situation is necessary. Kaffir corn for seed may be planted this month. Green-manure crops requiring a long growing season should be planted. Destroy, by feeding or burning, early planted trap crop of maize or volunteer plants which have become infested with stalk-borer. Plant the first of two traps for witchweed before the rains. It can be sown on a stubble and covered by disc-harrow.

If weeds are begining to show, keep the harrows going in front of the planters. If weeds are too advanced to be killed by drag harrows and too numerous to be dealt with by hand labour, use the disc-harrow or lightly re-plough the land. If the tilth is good, do not be afraid to harrow the young maize. This will save much labour later on by destroying the weeds while they are small.

Check-row your maize to reduce hand labour on witch-weed control, or plant at 6 feet by 9 inches and use a spring-tooth cultivator.

STOCK.

Cattle.—Normally rains should have fallen and the veld should be plentiful now. Beyond careful dipping, ranchers should not have much worry. If the season is bad, the poorer cattle should be drafted out and given a little hay, ensilage and maize daily.

In a normal year veld grazing should be plentiful in November, and the feeding of dairy stock is then very much simplified; veld grass in a green and succulent condition is practically all that is required for animals of less than average production. Heavy milking cows, however, on early pasture, require extra feed in the form of concentrates, while the latter should always be fed to dairy stock which are in poor condition at this time of the year. Young calves should not be turned out to graze with the herd, and in wet weather are best kept in a clean, dry, airy pen. Weaned stock, which have not hitherto had access to green pasture, should be

gradually accustomed to the change in diet and may at first be turned out to graze for short periods. Young stock on pasture should also receive a small daily allowance of concentrates.

Sheep.—The rams should now be working well, only allow the rams with the ewes at night. During the day they should be kept at home and allowed with the ewes from 4 in the afternoon until 8 or 9 in the morning. Keep all sheep on the high dry lands. Where hookworm is present dose now.

DAIRYING.

Farmers supplying cream to the creamery should adjust the cream screw to the separator so that the latter will separate a cream testing 45 per cent. butter fat. Cream of this consistency will keep better than thinner cream. It should be borne in mind that it is practically impossible to produce first-grade cream if the cattle are milked in a muddy kraal. In the absence of a cow shed, every endeavour should be made to erect a small milking shed in which four or five cows can be tied, milked and fed. A small shed of this kind is also essential to obtain clean milk for cheese-making. Milking in a muddy kraal invariably results in a gassy, bitter cheese being produced.

The shevles of the cheese room should be scrubbed with boiling water and soda, and for the last rinsing a weak solution of formalin may be used. This should prove effective in controlling cheese pests.

FLOWER GARDEN.

All seeds may now be planted. Annuals for January flowering should be sown, amongst which the following will be found to be excellent in this Colony:—Balsam, Calliopsis, Centurias, Chrysanthemum, Dianthus, Escholtzia, Marigold, Mignonette, Gallardia, Phlox, Poppy, Nasturtium, Nigella, Verbena and Zinnia. These are all hardy, and may be sown in the open either in beds or in the position desired for flowering. Advantage should be taken of each shower of rain during this month to keep the soil well worked and loose.

VEGETABLE GARDEN.

All vegetable seeds may be sown during this month. Tomatoes and early peas and beans should be staked. The soil should be kept loose and free from weeds, which now get troublesome. Sow pumpkins, mealies, peas and potatoes.

POULTRY.

Some birds will now be commencing to moult. This will cause a decrease in the number of eggs laid. The poultry keeper, therefore, should see that his birds come through the moult as quickly as possible. Some birds will lay and moult simultaneously, but there are the strongest, most vigorous and the best layers; the majority do not. The process of moulting is a natural one, but it is a severe strain on the system. Fowls that are not too fat, and can stand extra feed at the commencement of the moult, come through it best. More green and animal food should be given, and the utmost care taken that they are not exposed to cold or wet, otherwise they will not only take longer to moult, but go off in condition. A little linseed stewed, or linseed meal, or ground nut meal and milk should also be given. There will next month be a demand for table birds, and such as the poultry keeper intends to sell should be selected. In making this selection, it is no use choosing old or scraggy birds, for it is hopeless to attempt to fatten these, or make them good table birds. Do not coop them up till a fortnight or so before they are to be sold; give them free range and feed them well, with at least one feed of soft food mixed with milk once a day. Turkeys destined for the Christmas market should have free range, but also a feed of soft food once a day, and a good feed of mealies in the evening.

Price List of Forest-tree Transplants, Ornamental Trees and Shrubs, Hedge Plants. Creepers and Seeds.

OBTAINABLE AT THE GOVERNMENT FOREST NURSERY, SALISBURY.

AS AT 1st NOVEMBER, 1939.

1. Transplants of forest trees, etc., as far as in stock, are obtainable at the subjoined rates.

2. Orders should be addressed to the Conservator of Forests, Salisbury; or Manager, Forest Nursery, P.O. Box 387, Salisbury.

3. **All orders must be accompanied by a remittance in cash, bank note, postal order, draft or cheque, made payable to the Department of Agriculture, Salisbury. Under no circumstances will plants or seeds be sent out or taken away from the Nurseries unless paid for. Stamps to the value of one shilling will be accepted.**

4. All transplants are despatched at Rate 10 on railways at purchaser's risk. The transplants are watered as far as this is possible by the railway staff.

5. All prices quoted are for delivery free at any station or siding in Southern Rhodesia. Road motor service charges are payable by consignee and must be included in remittances.

6. Purchasers of trees contained in tins either of 25 or 4 trees are requested to return the tins, carriage forward, to the nursery from which they were obtained, or to the Manager, Forest Nursery, Salisbury. **If the tins are not returned within two months from date of issue, they will be charged for at the current rate of petrol tins (9d. each).**

7. No trees will be reserved unless specially booked. Orders will be executed in order of receipt as trees are ready for despatch. Every effort will be made to comply with instructions of purchasers.

8. Transplants of forest trees, when quoted at per 1,000, are grown in half paraffin or petrol tins containing 20 to 25

transplants. The average weight of each tin is about 25 lbs. Height of transplants, about 3 to 12 inches.

9. Transplants of larger size, from 1 ft. to 3 ft., are also supplied four in a tin at per tree Weight of tin, about 25 lbs.

10. Shrubs and ornamental plants in single tins have a weight of about 5 lbs.

11. To purchasers of forest trees, the following reductions are made:—

(*a*) When the number exceeds 1,000, the price is £3 5s. per 1,000.

(*b*) When the number exceeds 5,000, the price is £2 14s. per 1,000.

(*c*) Special quotation for orders over 20,000.

12. Orders for seed are posted or railed free of charge.

13. Though every care is taken to supply trees and seeds true to name and of good quality, no guarantee can be given in this respect, more particularly in regard to seed.

14. Intending tree planters are invited to apply to the Conservator of Forests, Division of Forestry, Salisbury, for advice as to the most suitable trees for growing in the various climates and soils of the Colony, and on the best methods to adopt in the formation of plantations, wind breaks and shelter belts.

15. No responsibility taken after trees, shrubs, etc., have been accepted by the Railways. Any claim for loss or death should be made to the Railway Company.

16. This list cancels all previous lists.

Price of Transplants.—For convenience, the following symbols are used to indicate the purchase prices of transplants:—

A—Trees, 25 in tin, at 2s. 3d. per tin, £3 5s. per 1,000; £2 14s. per 1,000 for orders over 5,000.

C—Trees and shrubs, 4 in tin, at 4d. each.

D—Trees and shrubs, 4 in tin, at 9d. each.

E—Trees and shrubs at 9d. each; extra large up to 2s. 6d. each.

Botanical Name.	Common Name.	Remarks.	Price of trans-plants.	Price of seed. Lb.	Price of seed. Oz.
Callitris calcarata ...	Black cypress pine ...	Usually rather slow growing, but reaches a fair size and produces a valuable durable softwood. Suited for dry country planting, especially in sandy soil. Good shelter for orchards, etc.	A. C.	15s.	1s.
Casuarina cunninghamiana	Beefwood	A fine large shade tree, suitable for avenues and narrow belts. Requires deep soil in drier localities. The foliage is useful for stock fodder, and the tree stands lopping well.	A.C.	...	2s. pkt. 1s.
Cedrela odorata		A rapid-growing tree similar to Cedrela toona, but with lighter foliage. Likely to do well on heavy soils, fairly free from frost. 30 to 40 feet in height.	A.		
Cedrela toona	Toon tree	A rapid-growing, handsome, semi-deciduous tree, suited for moister localities where frost is slight. Yields a valuable soft timber. Recommended for shade and ornament.	A. C.	15s.	1s
Cupressus arizonica ...	Arizona cypress	A hardy evergreen tree, suitable for dry localities, but requiring a well-drained and rather deep soil. Useful for shelter belts and also for hedges when closely planted.	A. C.	15s.	1s.
Cupressus lusitanica ...	Portuguese cypress ...	A fast-growing cypress, producing an excellent softwood timber, but requires a moist, cool climate and a good soil. May well be used for shelter and hedges in favourable localities.	A. C.	5s.	6d.
Cupressus sempervirens, var. horizontalis	Common spreading cypress	A hardy cypress, suited for limestone as well as other soils. Not so frost or drought hardy as Cupressus arizonica. Suitable for shelter and hedges.	A. C.	15s.	1s.

Cupressus sempervirens, var. pyramidalis	Common upright cypress	An ornamental tree for gardens and cemeteries. Also useful as a shelter tree. Grows under similar conditions to the "var. horizontalis."	A C.	15s.	1s.
Cupressus torulosa ..	Himalayan cypress. .	A good tree for timber, hedges and shelter. Withstands much cold and drought. Not very soil exacting. Fairly frost-hardy. A very reliable tree.	A. C.	10s	9d.
Eucalyptus botryoides	Bangalay	A large-leaved. heavy-foliaged gum. Quick growing. Suitable for granite and red soils. Withstands frosts, but not very drought-resistant.	A	15s.	1s.
Eucalyptus citriodora ..	Lemon-scented gum	A clean-boled tree. producing an excellent timber Leaves lemon-scented Suited for wetter regions and on the better soils in the lower rainfall regions. Will not withstand much frost or drought Flowers prolifically. rendering it very useful for honey production	A.	15s.	1s
Eucalyptus crebra . .	Narrow - leaved iron-bark	A slow-growing. deep-rooting species, producing excellent timber. Withstands drought and light frosts.	A	15s.	1s.
Eucalyptus globulus ...	Tasmanian blue gum	A fast-growing tree. suitable for cool. moist areas with deep soils Will not withstand drought, but is frost-resistant to a large extent. Produces a useful timber.	A	15s	1s.
Eucalyptus maculata ..	Spotted gum ..	One of the best trees for timber production or shelter in the wetter areas, being fairly hardy to drought but not to frost. Produces an excellent timber.	A.	15s.	1s.
Eucalyptus maideni	Maiden's gum	A very fast-growing, large tree, with bluish foliage in youth. Fairly drought and frost resistant. Will grow on poor soils if deep and well-drained. Produces a good, strong, useful timber.	A.	30s.	2s.

Botanical Name.	Common Name.	Remarks.	Price of transplants.	Price of seed. Lb.	Price of seed. Oz.
Eucalyptus melliodora	Yellow box...	A medium-sized tree, useful for shelter belts. Produces a tough, durable timber. Very resistant to drought and frost. Valuable for honey production, having abundant sweet flowers.	A.	15s.	1s.
Eucalyptus paniculata	Grey ironbark	A very good timber tree, with heavy foliage. Suitable for the moister regions, with a deep, fertile soil. Withstands some drought, but is frost-tender. Yields an excellent, hard, durable wood.	A.	15s.	1s.
Eucalyptus punctata ...	Leather jacket	A tree of fair size, yielding a good, durable timber. Adaptable as regards soil and climate, but will not withstand a dry cold climate.	A.	15s.	1s.
Eucalyptus robusta ...	Swamp mahogany	A quick-growing, shady tree, which requires a moist soil for best results, but will grow under fairly dry conditions, provided frost is not severe. Recommended rather for shelter belts than plantations	A.	15s.	1s.
Eucalyptus rostrata ...	Red gum	Produces an excellent and durable hardwood. Withstands drought, heat, brak, flooding and a good deal of frost. One of the best species for planting in Southern Rhodesia, except in sour soil and wet mountain regions.	A.	15s.	1s.
Eucalyptus saligna... ...	Sydney blue gum	A fast-growing, useful tree, producing a useful medium hardwood. Thrives on deep, fertile soils in the heavier rainfall areas. Tender to frost and drought.	A.	15s.	1s.
Eucalyptus sideroxylon	Red ironbark	A fairly slow-growing species, suitable for dry, rocky, soils in the moister regions. Produces a good, durable hardwood.	A.	15s.	1s.
Eucalyptus tereticornis	Forest red gum	Similar to Eucalyptus rostrata, and can be planted along with it, except in areas liable to flooding and great heat. Perhaps not quite as drought-resistant.	A.	15s.	1s.

Grevillea robusta	Silky oak	A handsome tree which thrives best in moist, warm localities. Useful for ornament, shade and timber. Frost-tender and not resistant to drought. If the locality is unsuitable, it may grow well for several years and then die out.	A. C.	...	pkt. 1s.
Jacaranda mimosaefolia	Jacaranda	An ornamental deciduous tree with feathery foliage and abundant blue flowers, which appear in spring. Best development is attained in the moister regions, but the tree withstands drought to a surprising extent, and may be planted in the drier regions if the soil is reasonably deep and fertile. It is tender to cold and frost, and may need protection in its earlier youth.	A. C.	20s.	1s. 3d. pkt. 1s
Pinus canariensis	Canary Island Pine	Hardy to drought, but not to severe frost. Best suited for planting on higher altitudes and in higher rainfall areas. Slow growth in early youth, then more rapid in later years. A handsome tree with inverted, umbrella-like branches, not spreading Yields an excellent softwood timber.	A. C.	15s.	1s.
Pinus halepensis	Aleppo pine	A drought-resistant pine which will grow on limestone and shale soils. Not recommended for plantations, but can be used for shelter and ornamental purposes in the drier regions.	A. C.	15s.	1s.
Pinus patula	Patula pine	A fast growing pine with graceful drooping needles. Does best in higher rainfall areas. Produces a useful softwood.	A.C.	15s.	1s.
Pinus radiata (insignis)	Remarkable pine	A large tree of very rapid growth, producing a useful softwood. Most at home in the heavier rainfall areas. Does not like sour or poorly-drained soils. Frost-hardy but not drought-resistant, usually failing at an early age in the drier regions.	A. C.	15s.	1s.
Pinus longifolia	Chir pine	A somewhat slow-growing pine, but useful to plant in localities where the climate and soil are doubtful at the higher elevations. For timber and ornamental purposes. A useful tree in all respects.	A. C.	15s.	1s.

Botanical Name.	Common Name.	Remarks.	Price of trans-plants.	Price of seed. Lb.	Price of seed. Oz.
Populus alba	White poplar	A rapid-growing poplar, requiring a good, deep soil in close proximity to running water. Propagated by suckers. Deciduous.	Suckers at 9s. per 100		
Populus deltoides, var. missouriensis	Carolina poplar...	A very fast-growing poplar, producing a very good timber for match boxes. Requires a rich, moist, alluvial soil. Moderately frost-hardy. Does not like stagnant water.	E.		
Salix babylonica	Weeping willow	A useful timber and ornamental tree, requiring a moist, well-drained soil which is occasionally flooded. Not suited for ground in which water is stagnant.	C.		
Ornamental Trees, Shrubs and Hedge Plants.					
Abelia floribunda	—	A shrub with myrtle-like leaves, evergreen if watered. Pink-white flowers in profusion. Is used for hedges in Natal.	E.		
Aberia caffra	Kei apple	A rough, thorny, impenetrable shrub, making a good hedge. Withstands frost and drought well. Suited for all but the driest areas of the Colony. More useful than ornamental. Slow growing.	E.		
Acacia baileyana	Silver wattle	A small ornamental tree with blue foliage and yellow flowers.	E.		
Acalypha marginata ...	—	Margin of leaf crimson; a shrub; will grow to 10 feet in height, or clipped to shape. Very useful to give colour to shrubbery.	E.		
Acrocarpus fraxinifolius	—	A small tree up to 25 feet in height; attractive foliage.	E.		
Agapanthus umbelatus	Cape Lily	Blue and white varieties.	E.		
Aleurites fordii...	Tung oil	An important oil-bearing tree from China. 25 to 30 feet in height	E.		
Aloysia citriodora... ...	Lemon-scented verbena	A small shrub with a strongly lemon-scented foliage Hardy, vigorous, quick-growing.	E.		

Alstonia scholaris	—	A white flowered shrub, 6 feet high, similar to Oleander.	E.	
Anona reticulata	Custard Apple	Small deciduous bush up to 10 feet high, bearing the well known custard apple.	E.	
Bauhinia galpini ...	Pride of de Kaap . ..	A rambling shrub, bearing orange-red flowers. Hardy.	E.	... pkt. 1s.
Bauhinia acuminata .	Bauhinia	A large, indigenous shrub, flowering profusely in early spring. White flowers. Hardy.	E.	pkt. 1s.
Bauhinia purpurea .	Bauhinia	Similar to the Bauhinia acuminata, but with mauve flowers. Hardy.	E.	.. pkt. 1s.
Bolusanthus speciosus	Rhodesian tree wistaria	An indigenous semi-deciduous tree with blue flowers at the end of long stalks. Ornamental.	E.	
Brugmansia knightii .	Moonflower	A flowering shrub with large, drooping, white flowers Strong scent (of lily) Fairly frost-hardy.	E	
Brunfelsia eximia .. .	Yesterday, to-day and to-morrow	Shrub 4 to 6 feet. Flowers change colour from purple to white as they grow older.		1s. each
Buddleia sp. .. .	Blue buddleia .	A medium-sized shrub with sweet-scented blue flowers. Useful as a hedge. Rapid-growing, but frost-tender.	E	
Buddleia sp.	Yellow buddleia	A rank-growing, yellow-flowering shrub. Useful as a hedge. Rapid-growing. Frost-tender.	E	
Callistemon speciosus	Bottlebrush ..	A scarlet-flowering shrub of drooping habit. Makes an excellent hedge if trimmed along the top only.	A.C.E.	2s. pkt. 1s
Carica papaya	Pawpaw .	A small tree with a large, dark green foliage, bearing large edible fruits	E.	
Casimiroa edulis . .	Mexican apple	A large, rapid-growing tree, 30-40 feet in height, evergreen, and bears a delicious fruit. A fine shade tree.	E.	
Cassia capensis	Cape laburnum ..	A rapid-growing shrub, bearing masses of bright yellow flowers.	E.	
Cestrum aurantiacum	Ink berry	A small shrub, bearing orange flowers in profusion.	E.	
Castanospermum australe	Australian chestnut	A very fine shade tree similar in growth to Cedrela but with shiny evergreen leaves and pretty flowers.		2s. 6d. each.

Botanical Name.	Common Name.	Remarks.	Price of trans-plants.	Price of seed. Lb	Oz.
Croton sylvaticus	Mount Selinda linden	A large-leaved, deciduous tree from Melsetter.	E		
Cyphomandra betacea	Tree tomato	The well-known tree tomato. Will grow anywhere where Paw Paws will thrive.	E		
Dahlia imperialis	Tree dahlia	A medium-sized shrub, making a handsome show with its single white blooms.	E	...	pkt. 1s.
Dalbergia sissoo	Sissoo	A large deciduous tree from India, producing an excellent timber. Desires a deep, porous, well-drained soil in close proximity to running water. Will not tolerate stiff clay. Frost-hardy, but not very drought-resistant. Rapid-growing.	E.		
Datura arborea...	Tree potato	A large shrubby tree, up to 30 feet in height, with large purple flowers. Very quick grower. Fruit poisonous.	E.		
Deutzia crenata	Bridal wreath	A small deciduous shrub with double white flowers, tinged slightly pink, on long, drooping stalks.	E.		
Dombeya sp.	—	A small shrub 6 feet high, pink flowers.	E.		
Duranta plumieri	Tree forget-me-not... ...	A medium-sized, deciduous shrub with blue flowers. Useful as a hedge. Very hardy.	E.		
Eranthemum sp.	—	A shrubby herbaceous plant covered with intense blue flowers in the autumn, likes shade. evergreen, 3 feet high.	E.		
Eugenia braziliensis ...	Brazilian cherry	A small shrub, bearing orange-coloured, edible fruits. A useful hedge plant.	E.		

Euphorbia splendens ...	Christ thorn...	A small thorny shrub with bright scarlet flowers Suitable for low hedges and borders.	E
Freylinia tropica	Inyanga hedge plant ...	A useful hedge shrub. Indigenous.	E
Gardenia florida	Katjepeering	A compact, evergreen shrub with dark green, glossy leaves and pure white, sweetly-scented double flowers.	E
Hamelia patens...	—	A compact shrub 8 feet to 10 feet in height, flower orange-yellow tubes, a showy shrub.	E
Heliotropium peruvianum	Heliotrope	A small shrub with sweet-scented lilac or nearly white flowers. Suitable in flower border.	E
Hibiscus rosa-sinensis	Chinese rose ...	Evergreen shrub with numerous scarlet flowers Double and single varieties.	E
Holmskioldia sanguinea	Holmskioldia ..	A fairly hardy shrub, bearing a profusion of brick-red flowers in large bunches. Suitable for hedges.	E
Holmskioldia sp.	Holmskioldia .. .	A yellow-flowering, handsome shrub similar to Holmskioldia sanguinea.	E
Hydrangea japonica ...	—	A well-known shrub. The flowers are naturally pink, and are changed to blue by feeding the plants with small quantities of Nitrate of Soda, as they grow	E
Hypericum lanceolatum	St. John's wort	A small, yellow-flowering shrub. Multitudes of flowers.	E
Iochroma tubulosa ..	Iochroma	A shrub with dark blue flowers	E
Lagerstroemia indica .	Pride of India	A large ornamental shrub, with mauve and pink flowering varieties. Handsome and hardy.	E
Ligustrum lucidum ..	Chinese privet	An excellent hedge plant or ornamental shrub or tree. Can be clipped into shape. Liable to die off in patches or lose its lower leaves unless planted in moist soil of fair depth. Propagated from cuttings.	A.C.
Lagunaria patersonii . .	—	An evergreen tree with pink flowers, 30 feet high.	E.
Mangifera indica	Mango	The well known fruit tree.	1s. to 2s. 6d. each.
Melia azedarach	Syringa	A deciduous tree, producing a good light timber Shallow rooting. Withstands drought well. Has fine lilac flowers and persistent yellow berries. Suitable for better rainfall areas and deep sandy soil, but will grow under severe conditions.	E

Botanical Name.	Common Name.	Remarks.	Price of trans-plants.	Price of seed. Lb.	Price of seed. Oz.
Morus sp.	Mulberry	A very large fruited variety.	E.		
Moschosma	Rhodesia spirea	A medium-sized, blue-flowering shrub.	E.		
Nerium oleander	Ceylon rose	The Oleander. Salmon-pink, also a white variety.	E.		
Parkinsonia aculeata	Jerusalem thorn	A light foliaged tree, up to 20 feet high, with little yellow flowers, very beautiful as isolated specimen on a lawn.	E.		
Persea gratissima	Avocada pear	A shrub with an edible fruit.	2s. 6d. each		
Philadelphus coronarius	Mock orange	A pretty deciduous shrub, large scented white flowers in early spring.	E.		
Photinia japonica	Loquat	A small evergreen tree with large leaves, bearing yellow edible fruit.	E.		
Phytolacca dioica	Belhambra	A rapid-growing, deciduous tree. Useful for ornament. Timber of no value, but seeds valuable as a poultry or cattle feed.	A.	...	pkt. 1s.
Pittosporum undulatum	Camphor laurel	An Australian evergreen shrub, making an excellent hedge, with shining, green, scented leaves and scented berries.	A.C.		
Plumiera rubra	Frangipani	A handsome shrub with pinkish red flowers. Rather delicate	2s. 6d. each		
Plumiera occulata	—	Similar to Plumiera rubra with white flowers.	2s. 6d. each		
Poinciana gillessii	Bird of Paradise flower	A shrub grown to 10 feet in height, thorny, flowers in clusters, orang-gold and red.	E.		
Poinciana regia	Flamboyant	A handsome red flowering, feathery foliaged tree.	E.		
Poinsettia pulcherrima	Poinsettia	A shrub with small yellow flowers surrounded by many large, scarlet, leaf-like bracts. Very showy. Double and single varieties. Also single pink variety.	E.		
Poinsettia albida	Poinsettia	As above, but with single yellowish white bracts.	E.		
Psidium pomiferum	Guava	A small, hardy, evergreen tree, bearing edible, yellow fruit.	D. E.		

Punica granatum	Pomegranate	A shrub or small tree, having shining leaves, large scarlet flowers and large red fruit. Makes a useful hedge when well cut regularly.	E.		
Pyracantha angustifolia	Hawthorn	Fruits golden and hang throughout the winter. Evergreen shrub. Useful as a coarse hedge.	A.C.E.		
Pyracantha crenulata ..	Hawthorn	Fruits scarlet. Evergreen shrub if watered in winter. Makes a good border or low hedge.	A.C.E.		
Rhus lancea...	Karreeboom	A small indigenous tree of graceful appearance, yielding a very durable wood. Useful for ornamental purposes. Forms a fine hedge.	A.	10s.	9d.
Roses (bush)...	—	An assortment of roses of about fifteen kinds, Teas, Hybrid Teas and Hybrid perpetuals, are usually on hand at 1s. each. These roses are struck from cuttings, but are not named.	1s.		
Russelia juncea.	Coral fuchsia	A pretty red-flowered shrubby plant about 6 feet high.	E.		
Salvia involucra	Salvia	Shrubby herbaceous perennial, growing to six feet in height. Red flowers. Very suitable for cutting.	E.		
Spathodea campanulata	African flame tree . .	A handsome, heavy-foliaged tree, bearing bright red flowers. Suited for the heavier rainfall areas on deep soils.	E.		
Spirea prunifolia	Cape May.	White flowered shrub four feet in height, in single and double varieties.	E.		
Streptosolon jamesonii	Streptosolon	A shrub with orange-coloured flowers in dense masses and pale green foliage. Very frost-tender and delicate.	E.		
Tecoma smithii	Tecoma	An upright, medium-sized shrub with tubular, bright yellow flowers. Forms a useful hedge. Fairly drought-resistant.	A. E.	...	pkt. 1s.
Tecomaria capensis ...	Kaffir Honeysuckle ..	A pretty trailing shrub from the Cape, with orange flowers.	E.		
Thevetia neriifolia... ...	Thevetia	An evergreen shrub, bearing bell-shaped, yellow flowers. Hardy.	E.		

Botanical Name.	Common Name.	Remarks.	Plants each.	
Thuya orientalis	Thuya	A very hardy conifer that withstands heat, cold and drought, and does not mind heavy soils. Slow-growing. Of small size. Very good for hedges.	A.C.	... pkt. 1s.
Trichilia emetica	Natal Mahogany	A fine shade tree, evergreen, slow in growth, height to 30 feet, spread up to 50 feet.		1s. 6d. to 2s.6d.
Zithryllum sp.	—	A deciduous shrub up to 15 feet in height, grown for its lovely leaves, which become highly coloured in autumn.	E.	
		Climbers and Creepers.		
Ampelopsis veitchii ...	Virginia creeper	Too well known to need description.	E.	
Antigonon leptopus ...	Coral Creeper	A showy climber, bright pink flowers, forms large bulbs underground. Takes two or three years to reach flowering size, after this it makes a wonderful display yearly.	E.	
Aristolochia elegans ...	Dutchman's pipe	A rank-growing creeper. Heart-shaped leaves. Purplish crimson flowers, spotted yellow.	E.	
Beaumontia grandiflora	Beaumontia	A large climber with heavy, glossy foliage. Large white, bellshaped flowers Blooms profusely. Fairly frost-tender.	1s 3d.	
Bignonia venusta	Golden shower	Vigorous creeper. Rapid-growing. Bears masses of orange flowers all the year round. Very useful and hardy.	1s. 3d.	
Bignonia speciosa	Bignonia	A rapid-growing, showy creeper, bearing large mauve flowers. Decumbent.	E.	
Bougainvillaea splendens	Bougainvillaea	Vigorous climber. May be also used as a hedge Bracts magenta. Fairly frost-hardy.	1s 3d.	

Ficus repens...	—	A valuable climber for walls, etc., used in places where the Virginia creeper is grown, but clings to the surface much better than the latter, rather slow at first.	E.
Hedera helix...	Ivy	A dark evergreen climber. Best in shady, cool climates.	E.
Jasminum sambac... ...	Jasmine	A vigorous, evergreen shrub climber with large trusses of fragrant, white flowers.	1s 3d.
Jasminum primulinum	Climbing jasmine . . .	A yellow-flowering species similar to Jasminum grandiflorum.	E
Lantana salviifolia. . .	—	A fine little creeping shrub with pink flowers, very suitable for rockwork, or edging borders, etc.	E.
Lonicera periclymenum	Honeysuckle (Woodbine)	Hardy climber with sweet-scented yellow flowers	E.
Lonicera sempervirens	Red honeysuckle	Climber with red flowers. Best kept well pruned or base becomes ugly.	E.
Mandevilla suaveolens	Mandevilla . .	Deciduous climber, bearing trumpet-shaped, white, fragrant flowers. Very slender.	E
Passiflora edulis . .	Granadilla .	A quick-growing climber, bearing edible fruits. Subject to woolly aphis if overshaded. A good trellis plant.	E.
Podranea brycei .	Zimbabwe creeper .	A rank-growing indigenous creeper with large, pink flowers.	E.
Rosa bracteata..	Macartney rose . . .	Plant with large green foliage and numerous white single flowers. Useful as a hedge plant.	1s.
Solanum wenlandii . .	Blue potato creeper .	A rapid-growing creeper with tubular, blue flowers. Not frost-hardy.	E.
Wistaria frutescens .	— .	The well-known climber with lavender coloured panicles of flowers.	E.

Palms, Bamboos, etc.

Botanical Name.	Common Name.	Remarks.	Plants each.
Arundo donax	Spanish reed	A reed growing 20 feet to 25 feet in height and 1 inch thick, and very superior to the indigenous variety.	Offsets 1s. 6d. each
Bambusa fortunei	Fortune's bamboo	A small variety, 6 feet high, with canes about the thickness of a lead pencil, extremely useful for stakes in the garden.	Offsets 2s. 6d. each
Bambusa arundinacea	Whipstick bamboo	About 30 feet.	Offsets 2s. 6d. each
Bambusa sp.	Japanese striped bamboo	A very ornamental variety with golden rods marked and striped with green lines, about 20 feet.	Offsets 2s. 6d. each
Bambusa sp.	Indian variety	Similar in growth to the Bindura, with very useful rods.	Offsets 2s. 6d. each.
Cortaderia argentea ...	Pampas grass	With long white plumes about 6 feet in height; must be grown near water or close to a tap.	Offsets 2s. 6d. each
Cyperus papyrus	Papyrus Grass	A very handsome subject for the water garden, or planted near the drip of a tap; it does best when growing in the water.	2s. 6d. each
Oxytenanthera abyssinica	The Bindura bamboo ..	The only variety indigenous to Rhodesia, giving very useful solid rods, very tough.	Offsets 2s. 6d. each.
Phoenix reclinata	Wild date palm...	A very hardy palm, indigenous to the Colony.	—
Phormium tenax	New Zealand flax	A useful green foliaged plant, about 4 feet high with sword-like leaves.	E.
Washingtonia robusta	Fan palm	A strong-growing fan palm.	—
		Palms 2s. 6d. to 5s. each.	

Offsets of Bamboos supplied during January only.

Compost.

By S. D. Timson, M.C., Assistant Agriculturist.

SECTION II.—EXPLANATORY.

The process of rotting. What is happening in the heap of compost.

In order to ensure that the composting shall be intelligently managed, and therefore proceed rapidly and economically, it is necessary to know something of what is happening in the heaps during decomposition.

The rotting of the waste materials is carried out chiefly by certain micro-organisms found in the soil Of these certain fungi commence the process of breaking down the organic material, and the bacteria assist and complete the work. In a properly rotting heap after the first turn the temperature should rise rapidly to somewhere about 130° to 140° F. within a few days, and soon after this the materials should be greyish white in appearance due to the growth of the white fungus mycelium.

An iron rod should be kept handy to the heaps for testing their temperature. It it is thrust into the heap and left to heat for a minute, and then pulled out and tested by hand it is possible to keep in touch with the process, and a little experience of this test soon indicates when a fresh turn is required. An undue drop in temperature usually indicates that more air is required, and either too little or too much moisture is present.

Both the fungi and bacteria require a proper supply of *water, air* and *nitrogen,* in order to carry on their work; also

a sufficiently high temperature, and a neutral or slightly alkaline medium to work in.

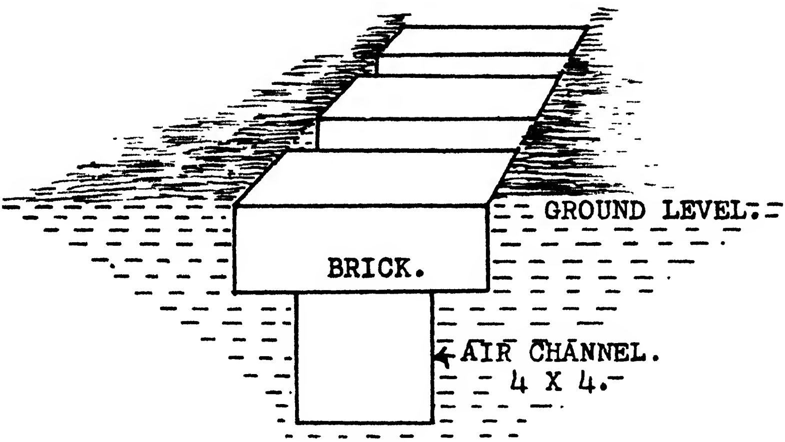
Water.—Sufficient moisture, but not an excess, is required. An excess causes a drop in temperature owing to the slowing up of the process. If at any time the heap becomes water-logged owing to continuous heavy rains, turning it will remove the excess moisture, and assist aeration at the same time. Excess of water tends to exclude air by packing the heap. If the heap becomes too dry, on the other hand, owing to a continuous drought, it may be spread out again into a heap 16 feet wide at any time, so as to ensure quick and ample wetting by the next rains; and then immediately after the rain it should be built up into a heap of the standard size of 3 to 3½ feet high by 9 feet broad.

Air.—An ample air supply is absolutely necessary in order to supply the oxygen requirements of the micro-organisms. This is regulated by avoiding trampling the heaps when building and turning; by shaking up the materials thoroughly at each turn; by avoiding excess of moisture by giving extra turns during heavy continuous rains as already mentioned; by avoiding the use of excessive quantities of soil; and by keeping to the standard dimensions of the heap laid down.

The experience of the last two years indicates that extra precautions are required in this Colony to ensure proper aeration of the heap, owing to the packing and temporary water-logging of the heaps during periods of heavy rain. It is, therefore, recommended that whenever possible one or two ventilating channels should be cut in the ground extending the full length of the heap and a yard or two beyond the heap at either end. If two channels are made they should be spaced about three feet apart and they should be made as follows:—

Cut a channel 9 inches wide and three inches deep. Down the centre of the floor of this channel cut another one 4 to 5 inches deep, and about 4 inches wide. Old bricks are then laid in and across the upper channel with a space 3 to 4

inches between them. The bricks serve to keep the lower air channel from becoming blocked. (See figure.)



These ventilation channels greatly assist the aeration of the heap in that part where aeration is most needed, namely, the bottom. The writer strongly recommends that they be used on any site which is regularly employed for compost, and he considers that even on temporary sites the small extra cost and trouble involved will be well repaid by the saving in the labour of turning, and by the better quality of the compost.

Green wastes should be withered before composting, since in the green sappy state they tend to close up the air-spaces in the heap, and so reduce aeration. Proper aeration is necessary not only to ensure the proper progress of rotting, but because in the absence of it large losses of nitrogen may take place owing to the activities of other types of micro-organisms which attack the nitrogen compounds, and break them down to free nitrogen gas, and gaseous oxides of nitrogen.

Nitrogen.—The micro-organisms require a sufficient supply of nitrogen for building up into their body protein. Part of the organic or combined nitrogen (chiefly in the form of proteins) is given off as ammonia during the rotting process, but this is absorbed by the soil and is converted into the nitrate form by other micro-organisms.

When the rotting process is finished the micro-organisms die, owing to lack of food, and the nitrogen in their cell or body tissue is converted by other bacteria in the soil into soluble nitrate nitrogen, which is directly available to plants.

Therefore during this process there is little or no danger of loss of nitrogen by leaching by the rains until the process of rotting is finished. In fact, when it proceeds properly, and there is no excess of nitrogen in the materials, large gains of nitrogen may be made from the air, by nitrogen fixation by free-living bacteria, and by the agency of the root nodule bacteria of the sunnhemp or other legume grown on the heaps.

In the cattle kraal, however, there are always huge losses of nitrogen to the air in the form of gaseous nitrogen and oxides of nitrogen or ammonia, and by the leaching of the urine, and nitrates by the rain.

Loss of nitrogen will, however, take place if the ripe compost is stored in heaps too long before use. But, this should seldom happen to any great extent in this Colony, since the process fits the seasons so admirably. The process commences with the rains, and should finish with the ending of the rainy season, and if the compost is then spread and ploughed under it is safely banked in the dry soil until the following crop is sown.

The proper supply of nitrogen is regulated by the proportions of dung and urinated soil added to the "mix" and by the proportions of the crop wastes of high or low nitrogen content which are employed. If the normal amount of dung is used then approximately 75 per cent. of the crop wastes may be of low-nitrogen content.

If no dung or other source of extra nitrogen is used then at least one-third of the wastes should be of high nitrogen content.

Below is a list giving the common farm wastes according to the rough classification used above.

High Nitrogen Wastes.	Low Nitrogen Wastes.
(1) *Young* green grass.	(1) Maize rubbish of all kinds.
(2) Soft green weeds.	(2) Old dry grass.
(3) Green sunnhemp, or other legumes.	(3) Spoilt hay and silage.
(4) Legume crop residues and spoilt legume hays.	(4) Stalks of sunflowers, cotton, and sunnhemp after harvesting.
	(5) Cereal straw and chaff.
	(6) Thatching grass.

The farmer will find the analyses of Rhodesian foodstuffs published as Departmental Bulletin No. 1035 of assistance. Any suitable material having a crude protein content of 10 per cent. or more can be placed in the category of high-nitrogen wastes.

If excess of nitrogen is present in the compost heap the process will proceed more rapidly, but loss of nitrogen will take place in the form of ammonia or nitrates, and this is uneconomic. If there is a shortage of nitrogen in the mixture then the process may be slowed down so much that it will not be finished in one rainy season. It may assist the farmer to mix his wastes economically if it is mentioned that one part of green sunn-hemp, not more than three months old, with three parts of wheat or barley straw without any other nitrogen supply, makes approximately a perfect mixture of materials for composting without adding any dung. Some soil, and wood ashes or lime, would also be required, of course.

Crop wastes may be composted in normal time without the use of any external source of nitrogen, either in the form of dung or any other material, providing the mixture of materials contains the proper proportion of nitrogen. *The use of some animal dung is always advised*, however, since there is an increasing body of evidence that, besides supplying nitrogen, and stimulating nitrogen-fixation, the use of animal dung leads to the ripe compost containing certain growth-promoting, or stimulating substances, without which crops do not thrive so well, and are not so resistant to diseases and pests. Some of these have already been isolated and synthe-

sised, and several are now marketed commercially for the purpose of stimulating the root-growth of cuttings. Such substances are known as Hormones.

Other Sources of Nitrogen.—One of the principal virtues of the Indore compost is that no materials except such as are present on any farm, on which oxen are used for traction, are necessary to make it.

Inorganic sources of nitrogen, such as sulphate of ammonia, nitrate of soda, cyanamide, nitrochalk, etc., have been recommended for composting low-nitrogen materials such as wheat straw, without the use of animal dung, by various writers in the local Press and elsewhere, recently, but *the writer strongly deprecates their use, save in exceptional circumstances, since thereby the cost per ton of compost is greatly increased, and this may render the process uneconomical.*

If inorganic sources of nitrogen alone are employed in composting, the cost of a 5 tons per acre dressing may rise to somewhere in the neighbourhood of £4 to £5, where only low-nitrogen material such as wheat straw are composted. The cost of making a 5 ton dressing of rain-watered compost, using only farm sources of nitrogen, should not exceed 10s., and should be appreciably lower under favourable conditions. Compost of high quality has been made in the Colony for less than 1s. per ton.

When organic, combined sources of nitrogen such as are found in animal dung, bone-meal, sunn-hemp and other vegetable materials, are properly employed, there should be no loss of nitrogen up to the completion of the rotting process, but definite gains.

Ayyar* has shown, however, that rapidly available inorganic nitrogenous compounds such as those mentioned above are unsuited to climatic conditions similar to ours, since they cause too rapid a decomposition in the early stages, resulting in loss of nitrogen. In heaps in the open a loss of 26-40 per cent. of nitrogen was observed. The use of slowly

* Utilisation of Farm Wastes. Agric. Jour., Madras, Vol. 21, p. 335.

available sources of nitrogen such as bone-meal and dung gave even rotting, and reduced the loss of nitrogen to 5 per cent.

Nevertheless, the householder who cannot employ animal dung, or the farmer or market gardner who, for some reason, finds it essential to speed up the composting process, may employ sulphate of ammonia, nitrochalk, or cyanamide as their sources of nitrogen. The amount required will vary greatly according to the type of materials to be composted, but as a rough guide it may be mentioned that 68.2 lbs. of sulphate of ammonia are required to rapidly decompose a ton of a material such as wheat straw, or maize husks and stalks, which have a low nitrogen content in the neighbourhood of 0.5 per cent., or a crude protein content of about 3.0 per cent.

Where about one quarter of the mixed wastes are of relatively high nitrogen content one pound to two pounds of sulphate of ammonia per cubic yard of wastes should suffice. *The actual minimum amount required must be found by experience, and if the same mixture of materials is always used this is simplified.* If ammonia is given off freely during rotting then the supply of sulphate of ammonia has probably been too generous, and must be cut down in future. If, on the other hand, too little sulphate of ammonia has been added then the rotting process will be unduly slowed down.

The same proportion of cyanamide as of sulphate of ammonia may be used. About 25 per cent. more nitrochalk must be employed, but since it contains 50 per cent. calcium carbonate, a parallel reduction in the amount of lime used may be made. Calcium cyanamide also contains lime, and in considerably greater proportion than in nitrochalk, since it contains a total calcium equivalent of 60 per cent. calcium oxide, or the equivalent of rather more than its own weight of calcium carbonate, or agricultural lime.

To yield about the same weight of nitrogen as 1 to 2 lbs. of sulphate of ammonia, $4\frac{1}{2}$ to 9 lbs. of bone-meal (4.4% N) are required, and these quantities will suffice for one cubic yard of wastes, of which about a quarter have a relatively high nitrogen content.

The use of bone-meal is recommended as an artificial source of nitrogen for composting, *where this is required,* and particularly where the phosphate content of the wastes, as in maize wastes and old dry veld grass, is known to be deficient, and where the price is about £6 per ton.

Recent investigations into the factors controlling the manufacture of compost, which have been carried out at the Imperial College of Tropical Agriculture in Trinidad,* have shown that the use of sulphate of ammonia as a source of extra nitrogen causes a considerable increase in the acidity of the compost heap. This is of course, undesirable, and it is therefore recommended that it should not be used if the other materials mentioned are obtainable.

Other Requirements of Micro-organisms.—*Phosphates.*—The micro-organisms carrying out the rotting of crop wastes require a certain amont of phosphate to use for building up into their body tissue. With a normal mixture of several types of crop wastes and residues, there will usually be sufficient phosphate for their use.

Where crop wastes such as maize wastes, and old dry veld grass or thatching grass alone are being composted, there may well be a shortage of phosphates, and the addition of a small quantity of one of the cheap basic phosphates such as rock phosphate may be added with the soil and wood ash. Besides phosphates, rock phosphate also contains bases, which are useful in maintaining the reaction of the compost heap near neutrality. The writer has used basic slag at the rate of 1 bag per 50 to 75 cubic yards of heap under such circumstances. Slag also contains bases, which are roughly equivalent in lime value to the same weight of agricultural lime. One bag of slag can thus, besides supplying phosphate, replace an equal quantity of agricultural lime, or three bags of wood ashes, in the compost heap.

Where an external source of nitrogen is also required bone-meal may be used to supply phosphate, since it contains about 4 per cent. of nitrogen in addition to the phosphate

*Experiments on Compost Making, by R. Cecil Wood, Emp. Jour. of Experimental Agriculture, October, 1938.

and also lime. Bone-meal contains bases, which are equivalent to about halt its weight of agricultural lime.

Bases.—The micro-organisms work most vigorously in a medium which is between neutral and slightly alkaline.

To ensure these conditions basic material such as wood ash, agricultural lime, and burnt lime are added to the compost heap. The wood ash contains a varying proportion of lime according to the amount of leaching by rain it has undergone. The more it has been leached, the higher is the proportion of the lime, since other materials such as the potash are lost. Wood ash in Rhodesia contains about 18 to 50 per cent. of lime (CaO). It also contains about 0.4 to 5 per cent. of potash, and the same percentage of phosphate oxide.

The ordinary loam soils which are approximately neutral, also contain bases, which are useful in maintaining the right reaction of the compost. The ordinary sandy soils are apt to be rather acid in reaction, and the sandy vlei soils are usually very acid. Some of the heavy black vlei soils, on the other hand, may contain a very high proportion of lime, and these would be particularly valuable for use in compost, since they would supply all the lime necessary, as well as the clay, fungi and bacteria.

Varying Proportions of Ash and Soil.—In the tables of proportions of materials given above the proportions of soil, and of lime and wood ash, vary. The reason is that if the amount of soil added is reduced below the maximum, then the proportion of lime or wood ash should be increased in order to adjust the amounts of lime and other bases added to the heap. It is better to err on the side of adding rather more ashes or lime than is necessary, than to add too little.

Soil.—The soil added to the compost heap is required for the following reasons:—

(1) To supply bases such as lime to neutralise acidity and maintain the reaction of the process near neutrality.

(2) To supply clay to form a collodial film on the surface of the waste materials, which assists the fungi rapidly to commence their action.

(3) To supply the necessary fungi and bacteria.

(4) To temporarily absorb ammonia.

Where the soil is known to be definately acid, the proportion of wood ash or lime should be increased, and that of the soil reduced to the minimum found by trial to be necessary.

Sandy soils do not supply much clay or basic materials, and it is recommended that never more than 18 parts by volume to 420 parts of wastes should be used, and trials should be conducted with less and less to find the minimum proportion. More lime should be added where sandy soil is employed than where loam soil is used.

Dung Slurry can replace Clay of the Soil.—The lack of clay in sandy soils can be corrected by sprinkling a thin slurry of *fresh dung* stirred up in water. If this is sprinkled over the materials as the heap is being built, a thin film is formed over the surface of the materials, which replaces or reinforces the film normally formed by the clay of the soil. This serves to assist the fungi to commence their work easily and rapidly, by giving them a supply of moisture, and food materials handy for their immediate use.

In the same way when the proportion of loam soil is reduced to the minimum, the lack of clay may be made good by the use of dung slurry.

Use of Dung Slurry always worth while.—The use of the dung slurry when building compost heaps can always be recommended, since it is extremely effective in ensuring a quick start of the rotting, and also, more important still, even rotting throughout he heap.

The little extra trouble caused by using it is far outweighed by the big saving of labour obtained by reducing the quantity of soil in the mixture to the minimum. When the normal amount of soil recommended for the Indore process is used (36 parts by volume in the above table of proportions) the soil represents a large proportion of the finished compost, and a considerable proportion of the labour employed is required for the collection and spreading of the soil, and later in riding and carting the ripe compost.

Reducing the Soil Increases Humus Content.—It must be borne in mind that such a reduction in the proportion of soil used will be followed by a proportionate increase in the proportion of humus in the ripe compost, and therefore of its manurial value.

The rate of application per acre can therefore be reduced. As a rough guide it may be stated that if a reduction in the soil be made from 36 parts to 18 parts by volume in the mixture recommended in Section I., then a 5 to 6 tons per acre dressing will be roughly equivalent to an 8 tons dressing with the full 36 parts of soil. The economy made in the labour of carting and spreading the compost will be obvious from the above figures.

Excess of Soil.—The use of any excess of soil beyond the recommended maximum is very inadvisable, since not only will it have the disadvantages outlined above, but it will cause the heaps to pack more, and air will be excluded; and loss of nitrogen will take place by the action of anaerobic bacteria in breaking down the nitrogen compounds to the gaseous forms, ammonia and free nitrogen.

Use of Minimum Quantity of Soil.—For these reasons farmers are advised to reduce the proportion of soil, especially sandy soil, gradually until they find the minimum required, and replace the clay and basic material in it, by the use of the dung slurry, and increased amounts of ashes or lime.

To be economic it is essential that the cost of making compost shall be reduced as far as possible, and this is one way of doing this.

The writer has found that, where the soil is red or chocolate loam, half the maximum proportion laid down will suffice to ensure good breakdown of almost mature sunn-hemp and old grass. The finished compost contained 5.3% more organic matter (loss on ignition) than that made with the full quantity of soil.

Cross-inoculation from Older Heaps.—Another means of speeding up rotting, and ensuring even rotting, is by inoculation of the heap at the first turn, by sprinkling a small

quantity of the material from an actively rotting heap about 10 days old over the heap as it is turned. The material taken should be white with the fungous growth.

When making the dung slurry, this fungus material can be mixed with it, together with some of the wood ashes or lime, to make a thin slurry, which is then sprinkled lightly over the materials as they are turned. Only a very light sprinkling is required.

In the same way at the second turn, a small amount of compost from an actively rotting heap about 30 days old may be lightly sprinkled over the materials as they are turned. This inoculates the heap with active bacteria.

When starting compost making, small "pilot" heaps can be made and watered artificially to provide the requisite material for these inoculations. In making winter compost these cross inoculations are particularly valuable, since they can be carried on from one heap to another successfully, and this is found to increase very greatly the virulence or activity of the strains of fungus and bacteria.

Cracking Hard Materials.—Hard materials such as whole maize stalks, cotton stalks, tobacco stems and roots, and sunflower stalks, are not easily attacked by the fungi, as they are protected by the hard woody "bark" or outer covering.

If these are included in the compost heap and it is desired to complete the rotting within the four months of the wet season, then they should be cracked or crushed, either by placing them in a cattle kraal for a week or two, or by placing them on a track or road freely used by farm traffic, or by running a heavy roller or culti-packer over them.

Where such materials form a large proportion of a compost heap there is a greater need to use dung slurry, and the full amount of soil, than for a normal mixture of materials.

Where sunnhemp is composted on the land it is strongly recommended that all such hard materials be mixed with the sunnhemp in the temporary kraals. This solves the problem

very simply, and the time and cost of carting will be repaid by rapid rotting, and a reduction in the labour of turning the heaps at the first turn.

Combined Use of Compost and Phosphatic Fertilisers.—Compost made by the methods described contains only a small percentage of phosphate, and it should be used in conjunction with dressings of phosphatic fertilisers. In this way the best results from both the compost and the fertiliser will be obtained. Particularly in acid soils the humus of the compost is extremely valuable in tending to prevent the fixing or immobilising of the added phosphates by the soil in a form unavailable to crops, by their combination with aluminium or iron. Thus the humus increases the availability of the phosphates added to an acid soil. It is possible that a reduction in the normal rate of application of phosphatic fertilisers may be possible where compost is used, but each must test this carefully for himself, and no general recommendation can be made.

Many farmers have asked the writer whether the separate spreading of the phosphatic fertilisers cannot be avoided by mixing the latter with the compost in the heaps. This can be done, of course, but if the farmer wishes to apply a definite amount of phosphatic fertiliser per acre, a carefully taken composite sample of the finished compost will have to be analysed, if he is to know just how much phosphate he is adding per acre.

The writer cannot recommend this method of applying the phosphates with the compost, since he is of the opinion that the farmer will have difficulty in regulating the exact application of the phosphatic fertilisers at the rates found most profitable by experience.

Compost and the Common Crop Diseases and Pests.—Since the compost is made from crop residues the question of whether diseases and pests can be carried over from year to year through the compost is one of some importance, particularly to the maize grower, who is composting maize residues, since the question of the control of the diplodia group of diseases is of some moment.

An enquiry was addressed on this matter to the Director of the Imperial Mycological Institute and his reply is given below:—

"Replying to your letter of the 20th March, I believe that there would be very slight, and probably no risk, of spreading the maize diseases caused by *Diplodia zeae* and *Gibberella saubinetii* by adopting the Indore method of composting the stalks, trash, and mouldy cobs, provided the material is suitably prepared and the method properly carried out. The optimum temperature for the germination of the spores of the mycelial growth of *Diplodia zeae* lies between 80° and 86° F. and the maximum between 95° and 104°; a temperature 10° higher than the maximum if maintained for a relatively short period under the conditions of aeration and humidity of the fermenting mass would destroy that fungus and other pathogenic fungi. In a normal fermentation the temperature during the first few weeks may rise to about 150° F. and be maintained near that for a considerable time; such a temperature under the moist conditions of the fermentation must be rapidly destructive to the pathogenic fungi."

It would appear, therefore, that where compost is properly made there is little or no risk of the spread of these diseases by its use. The same cannot be said of kraal manure, since high temperatures are not maintained throughout the manure for any time, and the possibility of danger in this regard must be borne in mind.

Tobacco Diseases.—Since it is known that some of the tobacco "spot" diseases will withstand the temperature of flue curing without being killed, it seems clear that there is danger in the use of the tobacco crop residues, such as primed leaf, old stalks and scrap, in compost which is to be applied direct to the tobacco crop.

If, however, the compost in which these minerals are incorporated, are applied to the crop (other than tobacco) preceding tobacco, there should be no danger of fostering the various diseases of this crop by the use of compost, and there is evidence that the proper use of organic manure renders the tobacco crop more resistant to disease.

Compost made from other materials, excluding tobacco wastes, can be safely applied to tobacco.

Pests.—The common maize pests, such as the stalk borer, ear worm and weevil, will not be able to live in properly made compost.

Eelworm, also, will not live through the composting process.

To sum up the position briefly, it is considered that the only danger of spreading plant pests and diseases by the use of properly made compost, is in the case of the tobacco crop as already mentioned.

SECTION III.

COMPOSTING THE SUNNHEMP GREEN-MANURE CROP.

There is undoubtedly a valuable place for Indore compost in Rhodesian agriculture as a means for eliminating the great waste of organic matter in the maize crop wastes, and the other crop residues which are burnt each year, and also in preventing the great waste of plant food which is being lost from the cattle kraals and feeding pens of the Colony, by the extensive leaching, and denitrification which take place.

However, the writer is convinced that there is a still greater field of usefulness for the modified technique of composting outlined below, which it is suggested should be applied to the sunnhemp green-manure crop.

It is necessary here to make it clear that at present the claims made for the system only apply to the sunnhemp crop, and to the heavier loam soils, and not to other green-manures or to the sandy soils. The evidence on which the system has been designed will first briefly be given.

Defects and Disadvantages of Green-manuring.—Although the practice of green-manuring has been of great value to Rhodesian agriculture, it suffers from the following serious defects and disadvantages:—

(1) A large proportion of a farmer's land is idle and unproductive each year under green-manure.

(2) The manurial value of the green-manure depends too much on factors outside the farmer's control, such as the rainfall following ploughing under, and preceding the planting of the maize crop. Results are variable and undependable.

(3) Much damage is done to the tilth of the heavy soils by the farmer being forced to plough under the crop when the soil is too moist, because he is working against the time factor.

(4) The top growth of the sunnhemp crop only gives a small additonal yield from the following maize crop compared with that given by the stubble alone.

(5) Only a portion of the green-manure crop can be ploughed in under the optimum conditions of time, soil conditions, and weather, owing to the slowness of ploughing.

(6) A second ploughing is nearly always necessary, and this is very hard on the oxen, and costs money.

Ploughing in versus Reaping Sunnhemp.—In five different series of experiments covering the past 11 years the increased yield of maize obtained by ploughing under the whole sunnhemp crop, as compared with ploughing under the stubble only, has been as follows:—1.10 bags per acre; 0.99 bag per acre; 1.94 bags; 0.91 bag; and 1.36 bags per acre. The average of these results is 1.26 bags per acre. This is borne out by the observations of experienced farmers, many of whom have informed the writer that they have been able to see no difference in the effect on the following maize crop of ploughing the whole sunnhemp crop in, and the effect of the stubble alone, where part of the crop has been reaped for seed.

It is necessary to emphasise that in this comparison of the manurial value of a sunnhemp stubble with that of the whole crop ploughed under it can only be fairly made where both are of the same stage of maturity. In other words, the effect of a sunnhemp stubble 10 to 12 weeks old cannot fairly be compared with that of a whole crop ploughed in at the

Rotational System H. Maize after green manure ploughed under plus 200 lbs. per acre superphosphate. Compare with maize which received farmyard manure in System F and note the healthier growth on this plot.

Rotational System F. Maize plus farmyard manure. The manurial treatment had very little effect on the yield of maize.

Maize which received compost made from sunnhemp tops Note drought resistance due to compost

Maize following sunnhemp burnt on the land. Note severe drought effect and compare with above photograph. Both plots planted same date, and photographed same date.

normal stage of maturity, which is about 16 to 18 weeks. From the results of past research, and also from the indications of field experiments which are not yet complete, it can be stated with reasonable certainty that, within certain limits which cannot yet be exactly defined, the more mature a sunnhemp stubble is the greater is its manurial value to a following crop of maize. Furthermore, it must be borne in mind that if the stubble of a sunnhemp crop (or of any other legume) is worked by plough or other implement before the seasonal rains end then a considerable loss of nitrogen and other soluble plant foods will be lost by leaching out to the sub-soil by the rain, particularly during the first month of the following rainy season when the maize crop is too young to take up large quantities of plant foods.

Therein lies one of the main advantages for the farmer of working with a stubble instead of ploughing the whole crop under. He need not (and should not) plough it until the rains finish, and he thus avoids much loss of plant food from the soil, particularly the nitrogen in the form of nitrate.

Manurial Value of Sunnhemp Compost.—Experimental *Evidence.*—In 1935-36 an experiment was laid down at the Agricultural Experiment Station at Salisbury with the object, amongst others, of finding the manurial value of the top-growth of a crop of sunnhemp, when it is reaped and made into compost.

The experiment was designed in the form of ten randomised blocks of six treatments; each plot was 1—20 acre in area. Only three of the six treatments are shown in the table of results given below, since those are the only ones of interest here. The full results were published and fully discussed elsewhere,* but it should be mentioned that the statistical analysis showed that the results were clearly significant, the calculated value of Z being 1.6892, and the observed value of Z at the one per cent. point being 0.6540.

The results are tabulated below, being expressed as the percentage increases in the yield of maize compared with the yield of the two controls reckoned as 100.

*R.A.J., September, 1938. Report on Experiments 1936-37.

Treatment.	Percentage increase in yield of maize compared to the controls reckoned as 100.
The whole sunnhemp crop ploughed under at 14 weeks from date of planting.	135.13
Compost made from the top growth of the sunnhemp crop cut at 14 weeks from date of planting.	139.94
Compost made from the top growth of sunnhemp crop returned to the land on which the crop was grown. Sunnhemp 14 weeks old when reaped.	159.49

It will be seen that the compost made from the top-growth of the sunnhemp crop by the method laid down in Section I. has a rather higher manurial value in the year of application than the whole sunnhemp crop ploughed under.

Reduction of Area of Idle Land under Green-manure Possible.—The above experimental evidence indicates that the farmer can with considerable profit reduce the areaof land idle under sunnhemp each year by at least fifty per cent. by composting the top-growth, since the stubble of a sunnhemp crop only gives on the average a yield of maize 1.26 bags per acre less than the whole crop of sunnhemp ploughed under, and the latter appears to be equalled in manurial value by the top-growth of the sunnhemp crop alone, after it has been made into compost.

Gains and Losses.—Before describing the modified system of composting suggested, the potential profits and losses of the system as compared with ploughing under the whole sunnhemp crop may be estimated in the case of a farm in the maize belt with 600 acres under the plough, of which 200 acres are normally green-manured, in order to illustrate the potential benefits of the system.

Under the system suggested only 100 acres of sunnhemp would be grown each year, and the top-growth composted and applied to the other 100 acres which would normally be green-manured. Of course, in the first year no compost is available, and the whole 200 acres should be under sunnhemp, and half or more of it would be composted.

Table of Potential Gains and Losses.

Losses.				Gains.			
(1) 126 bags of maize @ 8/3	£51	19	6	(4) 1,200 bags maize in 3rd year =	£495	0	0
(2) Cost of making compost @ 1/- per ton, and 10 tons per acre, on 100 acres . =	50	0	0	(5) Saving on 2nd ploughing of 200 acres @ 4/- . . =	40	0	0
(3) Complete fertiliser @ 200 lbs. per acre on 100 acres (14/- per acre) =	70	0	0	Total gains	£535	0	0
				Total losses	£171	19	6
Total losses	£171	19	6	Nett gains.	£363	0	6

The items in the above table may be elaborated as follows:—

Item 1.—This is simply the loss of yield on the 100 acres of stubble due to removing the top-growth, at 1.26 bags per acre, which has been found by experiments over 11 years as specified above.

Item 2.—Compost has been made in this Colony for 1s. 6d. per ton where all the materials were carted to a central site, and much hand labour used. It has been found by one farmer* who has composted 35 acres of sunnhemp tops on the lines suggested here, that the total cost of labour and depreciation on implements and kraals is less than 1s. per ton of compost where the yield of compost per acre is 10 tons.

*Composting the Sunnhemp Crop by P. G. Deeds. R.A.J., Oct., 1938.

It is estimated that the yield of compost per acre of sunnhemp will usually exceed 10 tons for a normally well grown crop in the maize belt, and for a heavy crop will reach 16 tons per acre.

Item 3.—This is a dressing of 200 lbs. per acre of a complete fertiliser having an analysis of approximately 25.1% P_2O_5 (total) 4.1% nitrogen, and 3% potash. The cost per ton of the materials for mixing on the farm is £6 5s. 0d. approximately. Railage and spreading are reckoned at 15s. per ton. This fertiliser has been used with success for several years by farmers in the Mazoe Valley and elsewhere.

Item 4.—The yield of maize in the third year, on the 100 acres which received compost in the first year, with 200 lbs. per acre of the above fertiliser, is estimated at 12 bags per acre. The average pay out per bag for the past three years is 8s. 3d.

Item 5.—On a sunnhemp stubble, or on a maize stubble, only one good ploughing is necessary, and thus the second ploughing necessary after ploughing in sunnhemp, which is so hard on the oxen, is avoided.

This table of losses and gains is merely intended to assist the farmer, who contemplates a change of system, to decide whether it may be worth his while or not, and it is only suggested that he should test the system on a moderate scale to start with until he has gained experience.

"Hidden" Gains.—Neither the extra cost of riding and spreading the compost, nor the costs of cultivation, reaping and marketing the extra 100 acres of maize are included. It is considered that these items may be more than balanced by the "hidden" gains which are to be expected, but are impossible to estimate accurately. For instance, the normal practice in the maize belt is to sow the sunnhemp crop in dry soil just before the rains. This means that much damage is done to the tilth of the heavy soils by ploughing it under whilst the soil is still moist during late February and early March, whereas in the system suggesetd the sunnhemp stubble should not be disturbed until the soil is dry, or almost dry.

Moreover, in a proportion of years heavy losses of maize may be caused, probably by leaching out of nitrogen by late rains in March and April, and particularly by the first month's rain of the following wet season, when green-manure crops are ploughed under in late February and early March. This is very well illustrated by the results of an experiment published in the October, 1937, issue of this Journal, where a sunnhemp crop of approximately 14 weeks' growth in each case was ploughed under at fortnightly intervals from February 21st to April 21st, 1936. The results are tabulated below.

Sunnhemp crop (in each case 14 weeks old) ploughed under on:	Yield of following maize crop per acre in bags of 200 lbs.	Percentage increase in yield due to later date of ploughing under.
February 21st, 1936	14.22	100
March 7th, 1936	15.36	108.08
March 21st, 1936	16.75	117.78
April 6th, 1936 .	17.56	123.41
April 21st, 1936 ..	17.75	124.89

The rainfall during March, 1936, was 5.44 inches, and during April, 1936, 0.56 inches of rain fell.

Since the sunnhemp crop was approximately the same age in each case at ploughing in, it is probable that the losses in yield of the following maize crop are due to the too early nitrification or rotting of the sunnhemp, and subsequent losses of plant foods due to leaching by rain. Much of this loss was no doubt caused by the first rains in November, 1937, before the young maize was able to take up the available nitrogen; certainly in the case of the sunnhemp ploughed in on the 6th and 21st of April, since only 0.30 inch of rain fell after the 31st March , and this fall was preceded by a dry period of several weeks and therefore probably had no leaching effect.

Losses by Leaching of Plant Foods Avoided.—Where the top-growth of a sunnhemp crop is removed for composting and the stubble left undisturbed until the cessation of the seasonal rains, these large losses should be avoided, since the micro-organisms in the soil require not only moisture but the ample supply of air brought about by ploughing to enable

them to convert the insoluble organic nitrogen, and other plant foods, in the sunnhemp stubble, into the soluble forms, which are subject to leaching by the rain.

In connection with the losses of nitrogen in the soluble nitrate form by leaching there is one point of great importance, which is usually lost sight of, and that is that nitrate does not pass out of the soil by itself. It must be in combination with some base. For instance, for every pound of nitrate nitrogen leached, either 0.7 of a pound of calcium (the active principle of lime), or 0.8 of a pound of magnesium, or 2.8 pounds of potassium are also lost, or equivalent proportions of all three.

It is therefore clear that green-manuring in this Colony must lead to considerable losses of available lime and potash from our soils. These can be largely avoided by the composting of the top-growth, and early planting of the following crop so that the latter will be in a position to utilise the nitrates as they are formed in the soil, before they can be leached away.

Again, it often happens that the ploughing under of the sunnhemp crop is unduly delayed by heavy rains, so that much of it is too mature to exert the best effects on the following maize crop.

The writer has frequently seen large areas of sunnhemp being ploughed under when almost mature. In such cases unsatisfactory results on the following maize crop may occur owing to (*a*) temporary nitrogen starvation of the young maize; (*b*) an excessively open seed-bed causing the soil to dry out unduly during the dry spells, and making it difficult for the roots of the young maize plants to obtain their food supplies; (*c*) phosphate starvation of the young maize owing to its temporary immobilisation by the micro-organisms carrying out the rotting of the sunnhemp; possibly also (*d*) shortage of oxygen in the soil for the same reasons mentioned under (*c*); (*e*) an inferior stand of maize due to unrotted material interfering with planting.

These ill-effects are obviously absent when a sunnhemp stubble is ploughed up after the seasonal rains have finished,

as is clearly proved by the remarkable stimulation of the young maize, which has been always noted, under varying seasonal conditions since 1931 at the Salisbury Experiment Station, and also in the Mazoe Valley and elsewhere.

When ploughing under a large acreage of sunnhemp there must necessarily be several weeks difference in the time of ploughing under of the first and last ploughed portions of the crop, with the inevitable losses already mentioned, due to leaching of plant food or over-maturity of the sunnhemp.

Some of the above losses can be partially avoided by later sowing of the sunnhemp, but this interferes seriously with farm organisation, and in any case green-manuring must remain a gamble on the weather conditions, since if later sowing is adopted the early cessation of the rains will entail a poor growth of sunnhemp.

Where the sunnhemp tops are composted, since the reaping will normally be done in dry weather and on dry soil, in the last week of March and in April, as mentioned below, all these difficulties are practically eliminated, and a much more dependable and regular manurial effect will be obtained over a period of years, than in the case of green-manuring.

(To be continued.)

**DON'T LET THE GRASS GROW UNDER YOUR FEET—
TURN IT INTO COMPOST.**

Mycological Notes.

13. DIPLODIA AND FIELD HYGIENE.

By J. C. F. Hopkins, D.Sc., A.I.C.T.A., Senior Plant Pathologist.

The Mycological Notes on the "Diplodia" danger which appeared last month in the journal have elicited a whole host of enquiries from maize growers throughout the Colony, and it is surprising to find so many farmers who are unaware of the details of seed treatment and the benefits to be derived from it. It is, however, gratifying to observe the ready response to the appeal for action to reduce the annual damage to the maize crop caused by disease.

Not only have enquiries been received regarding seed treatment, but considerable correspondence has dealt with growers' experiences and difficulties in controlling "Diplodia." Some have taken this Branch to task for exaggerating the dangers of the present position, whilst others have accused us of under-stating the case. Each correspondent is, of course, judging the statements published recently in the light of the condition of his own crop—more particularly this year's crop. Some growers have experienced heavier losses than usual during the past season, whilst others have been more fortunate, or have taken greater precautions, and find the mouldy grain to be somewhat less than usual. But a general survey of the Colony, as represented by the grain handled in the mills, shows that the amount of Diplodia in the last crop is much above average, and although the machines are set to clean the maize more thoroughly than is usually required, yet much of the meal is tinged with pink. The inference to

be drawn from this is that a very large number of cobs were this year attacked more or less severely by one of the "Diplodia" fungi, which accounts for the high percentage of infection.

Grain may not be visibly discoloured and yet be sufficiently badly diseased as to cause a set-back to the young seedling. Slightly discoloured seed may produce no plant at all, or perhaps only a weak, spindly one. Obviously discoloured grain will generally not germinate or, if it does, the emerging seedling will almost invariably die off. For all of these reasons, seed treatment with one of the mercury dusts available on the local market (namely, Ceresan and Agrosan) is urged upon all growers. Two pounds of dust to five bags of seed is the required dose, and the cost amounts to about 1½d. per acre. It is important to coat the seed thoroughly with the disinfectant, and this is accomplished by rotating seed and dust in a sealed drum for five minutes. Arrangements have been made with local agents to supply seed-treatment drums to growers at cost price, and it is understood that they are being stocked by the Farmers' Co-op Ltd., Salisbury. They cost £1, but a drum without fittings may be purchased for a few shillings.

So much for seed treatment. It is simple and cheap and goes a long way towards counteracting the effects of uneconomic farming methods. But "Diplodia" is so thoroughly established in Rhodesia and South Africa, that it is beyond human capability to-day to get rid of the disease by such a simple specific alone. Protecting seedlings is only one side of the question and does not strike at the root of the trouble. It is a necessary palliative as long as seed remains infected with disease, but it does not eradicate disease from farms where "Diplodia" is firmly established—that is on all maize farms in the Colony. There is just as much hope of banishing permanently the common cold from the human population by giving doses of cough mixture as there is of

completely eradicating "Diplodia" by the application of a seed dressing.

The problem must be tackled on a much wider basis and spectacular results must not be expected in one season. It is true to say that every farm in the Colony contains "Diplodia" in some guise or other. It may be in stalks imperfectly ploughed under; it may be in old cobs thrown on the ground during reaping; it may be in husks and cores left round the shelling dump, or it may be in litter lying round the kraal or the compost heap. Wherever it is, one thing is certain. The fungus will produce spores which will be distributed by the wind on the new crop, setting up infection which causes mouldy cobs and more infected seed.

There is only one effective way to reduce the amount of mouldy grain produced in the Colony and at the same time to decrease the high percentage of infection in the seed, and that is to remove the sources of infection by whatever means is practicable. Broadly speaking, there are two lines of attack

1. *Disposal of trash by*
   (*a*) feeding and/or
   (*b*) composting,
   (*c*) cutting and ploughing under early in the year,
   (*d*) burning where necessary.
2. *Rotation of crops.*

Both these methods can be rightly classified under the heading Plant Sanitation or Field Hygiene. If it can be understood that plants require hygienic surroundings in which to thrive just as much as animals and human beings require them, then it is obvious that infected vegetable matter, whether dead or alive, must be removed from the vicinity of growing crops. It is not the usual practice for human beings to have in their midst the corpses of fellow creatures who have died

of, say, small-pox, so why should it be considered safe to leave dead mealie plants, which are infected with "Diplodia," in the midst of a newly sown crop?

The life history of the "Diplodia" fungi, the damage they do and the ways in which they can be attacked have been worked out by scientists and the information passed on to the agricultural world during the past ten or fifteen years. Control measures have been standardised and are in general use in most civilised parts of the world, and although the scientist continues his investigations with the object of still further improving control measures, yet the stage has been reached when reasonable control rests not so much on the efforts of the scientist as on the efforts of the farmer. Plant hygiene is no more a matter for an expert than seeing that people keep their bodies clean is the duty of a doctor. To quote a recent editorial in *Tropical Agriculturist**: "The scientist should discover by research the vulnerable points in the life histories . . . and broadcast the information . . . and he may organise demonstrations and, by their means, create a temporary form of mass enthusiasm, even of mass hysteria; but sustained interest in sanitation must be born within the individual."

Efficient disposal of crop residues and carefully planned rotations are two of the main pillars which support the agricultural industry, but particularly where maize cultivation is concerned, these two pillars are extremely rickety and in most cases have been replaced by weak but showy substitutes or have been allowed to collapse. Unless they are quickly restored and assisted by the other two pillars, namely, good seed and seed treatment, there is danger of the whole edifice crumbling.

"Diplodia" can only be brought within reasonable control if the following practices are thoroughly carried out:

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*Trop. Agricst. (1939) xciii., 2, p. 66.

(1) Plant only good seed.

(2) Treat seed to protect the young plant.

(3) Dispose of crop residues by composting.

(4) Practice long rotations.

To argue that one or other of these methods is impracticable is no solution to the problem and will not eradicate "Diplodia." The practicability of an operation is governed by the will to try.

Bugs and beetles take their toll

but

Cleanliness Aids Insect Control.

Important to Maize Growers

Witchweed

By the Division of Agriculture.

Owing to the shortage of labour the control of witchweed by cultivation will probably be more difficult than it has been in the past, and every means of reducing the hand labour employed on this work must be utilised.

One of the best methods of economising hand labour for witchweed control is by wide-spacing of the maize to enable implements to be used for killing the parasite right through the growing season. A spacing of 6 feet between rows and 9 inches between plants in the row can be recommended, since this was found in a four years' trial at the Agricultural Experimental Station at Salisbury to give the same yield of maize as a spacing of 36 x 18 inches. Wider spacing between the rows and closer spacing in the rows caused a reduction in yield and are therefore not recommended.

The results of this trial are republished below to enable farmers to judge for themselves.

The following tabulation shows the average yields obtained from quadruplicate plots during the season 1932-33 and 1933-34 and the averages of similar trials during the two previous seasons.

Yields of Maize in Bags per Acre.

Distance of Planting.	No. of plants per acre.	Season 1933-34.	Season 1932-33	Seasons 1930-32.	Average 4 Seasons (18 plots)
3 ft. x 18 ins.	9,680	22.14	16.61	20.61	20.11
6 ft. x 9 ins.	9,680	22.48	16.55	20.33	20.00
9 ft. x 6 ins.	9,680	19.03	16.00	17.24	17.35
9 ft. x 9 ins.	6,453	17.75	15.50	16.23	16.39
9 ft. x 9 ins.	+Beans	17.18	15.59	15.49	15.86

A spacing of 6 feet enables a section of a spring-tooth harrow to be used for cultivation, and a light pole attached to its rear enables it to be steered close to the rows.

An ordinary 5 or 7-tined expanding cultivator can also be conveniently used, and this is preferred by one experienced farmer, though he did not test the section of spring-tooth harrow with a steering handle attached to the rear. A half "sweep" should be attached to the rear inside point of the ordinary cultivator. The point of this can then be worked close to the row.

Where hand-planting is done, a spacing of 6 feet by 18 inches, leaving two plants to the hill, can be used. This spacing was successfully used last season.

It is realised that fallen or wind-blown maize stalks towards the end of the season will interfere with the work, but much labour can be saved before this point is reached; and it is likely that in many cases the labour required to lift and tie up the maize to allow cultivation will be less than that required to hand cultivate the witchweed. Especially will this be true where the infestation is severe.

Furthermore, we now know that much of the "wind-blowing" of maize is due to the attacks of the Diplodia group of diseases weakening the stems and their anchoring roots. This trouble can be appreciably reduced by treatment of the seed by one of the mercurial compounds which are recommended for this purpose. Particulars of this treatment can be obtained from this Department. It is particularly necessary to carry out this treatment of the seed this year, because of the serious infestation of seed maize by Diplodia that has been found to exist, owing to the excessively wet summer of last season.

In conclusion, farmers are reminded that last season was unfavourable to the germination of the seed of witchweed, and that means that there is an abnormal quantity remaining in the soil awaiting germination this season.

Southern Rhodesia Veterinary Report.

SEPTEMBER, 1939.

DISEASES.

African Coast Fever was diagnosed on the farm Quarries, Salisbury native district.

TUBERCULIN TEST.

Thirty-two bulls and 32 cows were tested on importation. Two reactors were destroyed and four doubtful reactors are being held over for a further test.

MALLEIN TEST.

Nineteen horses and 30 mules were tested with negative results.

IMPORTATIONS.

From Union of South Africa: Six bulls, 13 cows and calves, 19 horses, 30 mules, 1,261 sheep, 20 pigs.

From South West Africa: Twenty-four bulls, 2 cows, 2 calves, 8 heifers.

From Bechuanaland Protectorate: 368 sheep.

EXPORTATIONS.

To Union of South Africa: 582 oxen, 61 cows.

To Portuguese East Africa: 178 cattle.

To Belgian Congo: 2 bulls, 19 cows.

Eleven bulls imported from the Union of South Africa for show purposes were re-exported to the Union during the month.

EXPORTATIONS—MISCELLANEOUS.

To United Kingdom: Chilled beef quarters, 1,501; frozen beef quarters (chilled quality), 3,846; frozen quarters (fair average quality), 392; frozen boneless beef quarters, 362; tongues, 3,057 lbs.; livers, 12,494 lbs.; hearts, 5,396 lbs.; tails, 1,231 lbs.; skirts, 2,407 lbs.; shanks, 975 lbs.

To Northern Rhodesia: Beef carcases, 22; mutton carcases, 20; offal, 1,215 lbs.

To Belgian Congo: Beef carcases, 288; offal, 145 lbs.

Meat Products from Liebig's Factory.

To Union of South Africa: Corned beef, 51,576 lbs.; rolled beef, 360 lbs.; sausages, 825 lbs.

To Basutoland: Corned beef, 2,640 lbs.

To Bechuanaland Protectorate: Corned beef, 2,700 lbs.

To United Kingdom: Meat extract, 14,028 lbs.; beef powder, 9,005 lbs.

B. A. Myhill,
Chief Veterinary Surgeon.

THE RHODESIA

Agricultural Journal

Edited by the Director of Agriculture.

(Assisted by the Staff of the Agricultural Department).

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Editorial.

Contributions and correspondence regarding subjects affecting the farming industry of Southern Rhodesia are invited. All communications should be addressed to:—The Editor, Department of Agriculture, Salisbury. Correspondence regarding advertisements should be addressed:—The Art Printing Works, Ltd., Box 431, Salisbury.

Southern Rhodesia Egg-laying Test.—It has been decided to continue the Egg-laying Test and poultry farmers are reminded that entries for the next test close on January 19th, 1940. Full details, regulations, etc., can be obtained from the Poultry Officer, Box 387, Salisbury.

December Cleanliness Hints.—Keep lands free of weeds. Grass weeds, especially, should be kept under control in maize lands, for army worm outbreaks may start before the end of the year. Army worm has a preference for sweet grasses, such as rapoko and red-top, upon which to deposit eggs. Weeds on all lands should be destroyed before insects can

mature on them. They should be kept under control at all times to assist in keeping down a large variety of crop pests.

By the middle of the month, remove volunteer maize plants from all lands and destroy them by feeding them to cattle, or by other suitable methods. As they are usually further advanced than the maize crop, particularly this season, they act as a trap crop for the maize stalk borer, and should be destroyed both to prevent the borers from maturing in the plant, and to prevent their migration, as caterpillars, to the crop. If the volunteers are not in or near maize lands, they can be left until the end of the month before being destroyed.

Destroy volunteers or re-growths of tobacco, and dig over those seed-beds that are no longer required. Destroy all weeds near the seed-beds.

Cleanliness Aids Insect Control.

Tobacco Research

PROGRAMME FOR PRESENT SEASON.

At a special meeting of the Tobacco Research Board held in September it was decided to carry on the work of the Trelawney Research Station for the present season. It was found necessary to reduce the programme which had been approved earlier in the year so that the work could be carried on by the reduced staff of four officers. In previous years the individual officers all submitted individual programmes for the approval of the Board, although the organisation of the work, including seed-beds, planting, reaping, curing and baling was arranged collectively. This season the only four remaining officers, *viz.*, H. F. Ellis, M.Sc., Dr. A. A. Moffett, I. P. Norval, M.Sc., and H. M. Murray, B.Sc., undertook to revise the programmes in such a way that they considered the work could be satisfactorily carried on by closer team work.

Culture and Fertiliser Tests.—Continuation on same land of N.P.K. fertiliser trial originally laid down by Mr. Thorpe. Potash has shown no significant differences, and it is intended to substitute three levels of compost for the three potash levels, each plot receiving a uniform potash dressing. Testing the effects of compost made from tobacco stalks on tobacco planted on old and rather washed land. Modification of spacing treatments to test three spacings best suited for body instead of nine previous treatments. Continuation of rotation trials, hree year rotation now due for planting to tobacco. Continuation of time of application of fertiliser trials with modification to test best methods and type of fertilisers to be used for side applications. Continuation of mulching experiment. Continuation of experiment on sources of nitrogen combined with tests of local formulae and best formulae found in N.P.K. test. Tests of cultivation as opposed to elimination of weeds. Continuation of curing experiments with ethylene.

Continuation of experiment on comparison of Rhodesian and American methods.

Plant Breeding.—Thirty-six strains of a number of varieties, containing last year's main line of work. Trial and selection of more recently imported varieties, probably 8 in number. Mosaic resistance. The experiments will be planned in such a manner that they can, should the necessity arise, be considerably reduced, without affecting the essential basis of the breeding work. It is felt, however, that as the main work on the breeding side comes before reaping or curing there should be no difficulty in carrying out the programme in full.

Biology.—Field control of Rosette by roguing. Steam sterilisation of seed-beds. Seed-bed spraying: the effect on plant growth and disease incidence. Field spraying and dusting to control leaf-spotting diseases. The effect of priming on spot control and leaf value. The effect of varying fertiliser constituents on the incidence of frog-eye. Barnspot: effect of regular and delayed picking of leaf, of varying starting temperature of barns, of fumigation in the barn. Field sources of angular leaf spot. Observational work on conditions favouring Alternaria spot. Eelworm control: (*a*) Silver treatment; (*b*) rotations.

Chemistry.—Continuation of analysis of American and Rhodesian grown tobacco and comparison of the two types. Continuation of the comparison of first year, second year, etc., soils with special reference to the availability of potash and phosphate and the amount of the forms of nitrogen and of organic carbon. Continuation of lysimeter experiment. Continuation of the investigation of the uptake of chlorine in tobacco receiving a side dressing of common salt, and the interaction between chlorine and nitrogen. Study of leaf composition in different positions on the plant. Comparison of soil samples from two adjacent fields, one contour-ridged and cultivated along the contour; the other cultivated according to the old methods. Comparison of tobacco yields from the two fields. Study of the effect of compost on the composition of soil which has been under tobacco continuously for several years, at the same time comparing the tobacco from composted and control plots.

Fig. 63. *Kigelia pinnata* D.C The "German Sausage" or Cucumber Tree

Fig 64. *Swartzia madagascariensis.*

Fig. 65. *Pogonia purpurata.*

Fig 66 *Lissochilus speciosus* R.Br.

Fig. 67. *Lissochilus Krebsii* Reichb. f.

Fig. 68. *Lissochilus arenarius* Lindl.

Fig. 69. *Eulophia Zeyheri* Hook f.

Fig 70 *Eulophia livingstoniana* Reichb.

Trees and Wild Flowers

ON THE RHODESIAN FARM.

By CHAS. K. BRAIN, M.A., D.Sc., Director of Agriculture.

PART X.

Kigelia pinnata D.C. Cucumber Tree. Fam. *Bignoniaceae.*—A fine straight tree 20-50 feet high, only growing to perfection at less than 3,000 feet altitude. Bark thick, smooth dark grey. Leaves with 7 or 9 large leaflets, the terminal one the smallest, the paired leaflets up to 5 inches long and 3 inches broad. The flowers which are produced about June are on long pendulous stems, bell-shaped $2\frac{1}{2}$ inches long and 1 inch in diameter, intense crimson or claret-coloured inside and velvety. Fruits usually 12 to 20 inches long, sometimes weighing 8 lbs. (Fig. 63) on long stalks. Wood soft, yellowish or whitish, suitable for making boxes. Occasional trees occur within 25 miles of Salisbury, but they are common at lower altitudes.

Swartzia madagascariensis Desv. "Sausage Tree." Fam. *Leguminosæ.*—A small tree with a dense rounded crown. Leaves with 9-13 leaflets, which may reach $2\frac{1}{2}$ inches long and $1\frac{1}{2}$ inches broad. This tree flowers in October to November when new leaves are developing. The buds are round and dark brown. The fragrant flowers are remarkable in having only one large crinkled petal and numerous stamens. The hard, brown, shiny, sausage-like pod reaches 10 inches in length and nearly an inch in diameter. (Fig. 64.) This tree is common and widespread through tropical Africa.

Some Ground Orchids in Flower at Present.—All species described here have been collected on the Salisbury Show Ground within the last two weeks.

Pogonia purpurata Reich. f.—Stem about 6-10 inches long, fleshy, stout, yellowish green or mottled with brown. Leaves absent at the time of flowering, but a single ovate

leaf about 4 inches long is produced from a separate bud after the flowers are over. Flowers usually 2 or 3 near the top of the stem about 1 inch to 1¼ inches long, pendulous. Sepals and upper petals similar, yellowish-green or faintly mottled, not reflexed but close to column and lip. Lip about an inch long, trough-like with wide side lobes, greenish white with many wavy purple lines. Floor of the lip flat, without a spur, with the edges of the flat part raised in two lateral ridges and a raised line in the centre. (Fig. 65.) Usually growing in small groups of ten or fifteen plants a foot to a yard apart. This is the first known record of this orchid from Southern Rhodesia.

Lissochilus and Eulophia.—Most of our common ground orchids belong to one or other of these two genera. They are closely related and are only separated as a matter of convenience. In the former the two upper petals are nearly as wide as long and are usually upright and flaring, and often of a different colour than the sepals. In *Eulophia* the upper petals and sepals are more or less alike in colour and form. In both cases the lip in our species has a spur which may be slender, more or less clubbed, or broad and cup-like.

Lissochilus speciosus R.Br.—This is our commonest sandveld ground orchid with stems usually about 18-24 inches high with large yellow flowers. The sepals are short, greenish and reflexed. The petals are broad, deep yellow. The lip is broad, with upturned margins and raised ridges running the whole length. The lobes of the lip are upright, paler yellow, with a few reddish or purplish radiating lines. (Fig. 66.) The spur is short, conical, laterally compressed. Common, flowering November-December.

Lissochilus Krebsii Reichb.—This is our tallest ground orchid, reaching 6 feet high in good soil. The stems arise from pseudo-bulbs which are yellowish green and 3-4 inches long above the soil. Leaves are usually half developed before flowering is over. They are often 1 foot long and 3 inches broad, pleated with prominent veins. The flowering stalks are thick and the flowering part at the top is often 18 to 24 inches long. The flowers are wide-spaced, large, deep purple

brown and yellow. The sepals are $\frac{3}{4}$-1 inch long, $\frac{1}{3}$ inch broad, pointed, dull greenish outside, deep purple brown above, reflexed. The two upper petals are large, flaring, almost as broad as long, deep yellow outside and whitish within. The lip is strongly recurved, the end part deep orange, the lobes and base similar in colour to the sepals. The spur is short, stout, deep purple. The column is broad, creamy white (Fig. 67.) Very common on the Eastern Border, widespread but not so common elsewhere.

L. arenarius Lindl.—Flowering stems up to 30 inches high. Flowers somewhat like a short broad foxglove flower, pale mauve with a purple lip with yellow in the back of the throat. The flowers are widely spaced, often 8-10 blooms in the upper 6 or 8 inches of the stem. The sepals are brownish purple, very much reflexed. The upper petals are broad, roundly arched, pale mauve to purplish with broad up-turned margins. The lip is very broad and hollowed, with a wide throat with a pair of stout processes in front of the sac, which is as broad as long. The column is pale, curved, club-shaped. (Fig. 68.) Common and widespread.

Eulophia Zeyheri Hook f.—This is one of our most widespread ground orchids, particularly common along the Eastern Border, where it is often called the "Rhodesian Chinkerinchee." The stems are usually 12-18 inches high, stout, with the young pleated leaf almost as long at the time of flowering. The flowers, 15-20 in number, are densely clustered in the upper few inches of the stem, with flowers opening from below and buds above. The flowers are usually 1-1$\frac{1}{4}$ inches long, pale to rich canary yellow with the inner half of the pointed lip deep orange, and the side lobes to the lip and the column deep purple-brown. In our specimens the lip does not have the red veining illustrated by Dr. Bolus for the South African specimens, but the orange hairs are present around the throat. The sepals and upper petals are similar in length and colour and are not reflexed. (Fig. 69.)

Eulophia Livingstoniana Reichb f.—This is one of our most dainty ground orchids. The stems are about 18-24 inches high, moderately slender, dark green, with 8-15 widely spaced flowers or buds in the upper 6-10 inches of the stem. The

sepals and upper petals are about the same length and breadth, i.e., nearly ¾ inch long and almost a third as wide, but appear narrower because the edges are turned backwards, waxy, white or pale mauve, the lip itself has the margin crinkled and is deep purple. The lateral lobes of the lip are upright flaring, rounded and greenish and the curved column is deep greenish purple. The spur is conical, compressed from front to back. (Fig. 70.) Common particularly in stony red soil.

HONEYED WORDS.

A Bee in the Bonnet's worth Two in the

JAM.

Get busy and Let your

BEE

be

" *Cleanliness Aids Insect Control.*"

Farming Calendar

JANUARY.

FORESTRY.

If the rains are seasonable, plant out evergreen trees, such as gums, cypress, pines, etc. Fill in all blanks as soon as they are noticed, and do not leave them until the following season. Planting should be done on a wet day or, failing that, on a dull day, or late in the afternoon. Great care should be taken to see that the trees are not planted out any deeper than they stood in the tins or beds.

CROPS.

Turn your compost heaps on a wet day. Plough under witchweed traps within two months from germination. If only one trap is being planted, plant this month. If not already sown, put in the ensilage and fodder crops at once, such as maize and legumes, Kherson and S.E.S. oats and other hay grass crops. Sow short season crops like haricot beans, linseed, buckwheat, peas, summer oats, gram and mung bean, and sunnhemp for hay. Plant out grasses and kudzu vine for pasture. Ridge potatoes and cultivate thoroughly. Main crop can still be planted. Quick growing green manuring crops, such as cowpeas, soya beans and sunnhemp, may still be sown this month. Earth up ground nuts so that a small amount of loose soil is thrown over the crowns of the plants. Cultivate all growing crops well, and thoroughly eradicate weeds. Overhaul all hay-making implements and ploughs and get in thorough repair in preparation for the haying and ploughing seasons. Endeavour to mow grass fields early for hay and litter, and to obtain second cutting for hay in April. Mow grass paddocks infested with annual weeds to prevent the weeds seeding. Prevent Mexican marigold and other noxious weeds seeding by hoeing or pulling out the plants by hand. Keep a sharp look-out for maize stalk borer. Cut off the tops of infested plants or treat

them with a recognised chemical preparation. Watch the maize lands for witchweed. Prevent witchweed plants from seeding by cultivation and by hand-pulling the plants. Make as much manure as possible by placing sunnhemp, grass, and litter in cattle kraals, pig sties and stables. If there is stumping and clearing to be done, push on with it.

STOCK.

Cattle.—Put the bulls into the herd now to secure spring calves. The bulls should be in good condition at the commencement of the service season and their condition should be maintained while they are working. This season calves should be looking well by this time and care must be taken not to over-milk the cows in consequence. Cows rearing calves should not be milked more than once a day. Bullocks which are being fattened on grass should receive a concentrate ration from now onwards; 4-5 lbs. maize meal daily should be sufficient.

During the months of December and January veld grazing is usually plentiful, and very little extra feed in the form of concentrates is required for dairy stock. It should be borne in mind, however, that heavy milking cows are unable to satisfy their requirements for milk production from veld grazing alone, and should receive a daily allowance of grain; the latter should be fed at the rate of 2 lbs. for every gallon of milk produced daily, *i.e.*, a cow producing three gallons of milk should receive 6 to 7 lbs. of concentrates. An excellent mixture for this purpose is one consisting of four parts maize meal and one part ground-nut cake.

During wet weather, the provision of a clean dry shelter for calves is essential; the latter should not be crowded together in a small, damp, badly ventilated pen or muddy kraal. When treated in this manner, a calf is very liable to contract various ailments such as scour, etc. Scour is entirely preventable, and is usually caused by over-feeding, or feeding from dirty pails, feed boxes, etc. Calves which contract scour should be isolated, the milk ration reduced, and they should be dosed with a few tablespoonfuls of castor oil.

Sheep.—Keep the sheep away from vleis. During this time of the year they are liable to suffer severely from internal parasites and dosing should be regular. If nodular worm is present dose twice at 30-day intervals with the new remedy.

DAIRYING.

Under the weather conditions which now obtain, cream should be despatched to the creamery at least three times a week. It is of the greatest importance that cream should be cooled immediately after separation, and should be kept cool while on the farm and whilst in transit to the railway station or siding. While the cream is being cooled, it should be frequently stirred, using a stirrer with a plunger attachment. Warm, freshly separated cream should not be mixed with old cream which has already been cooled. Cool the fresh cream first and then mix thoroughly with the old cream. Gassiness is a common defect in the cream received at the creameries at this time of the year, and is caused by gas-producing organisms with which the milk and cream are contaminated. These organisms abound in mud, manure, stagnant water, etc., and develop and multiply very rapidly at high temperatures. Any precautions therefore which may be taken to eliminate dirt, manure, etc., from the milk and to keep the cream cool will prevent the development of gassiness.

As the night temperatures are fairly high, cheese-makers should not attempt to use night's milk for cheese-making; morning's milk plus a starter will give the best results. Gouda cheese-making operations are not usually successful at this season of the year, owing to the poor quality of the milk and the prevalence of gassiness. This type of cheese is best manufactured during March and subsequent months.

VETERINARY.

JANUARY-MAY.

Tick life will be very active and in consequence tick-borne disease in evidence, especially redwater and gallsickness, and in districts where the bont tick prevails heartwater in cattle and sheep must be expected. Regular dipping to destroy tick

life and minimise losses from disease should be conscientiously carried out. Horse sickness may be expected during these months and until the first frosts appear, usually about June. Blue tongue in sheep will be prevalent in uninoculated sheep. The inoculation of sheep against this disease should not be undertaken in the wet season unless animals can be kept under cover for 21 days following inoculation, and on account of possible abortion resulting, ewes in lamb should not be inoculated. Screw worm may be prevalent.

FLOWER GARDEN.

This month requires all one's energy in the flower garden. Annuals may still be sown for late flowering before the season is over. Planting out should be done as early as the weather permits, and advantage taken of a dull day after a shower for this work. If care be exercised much smaller plants may be put out than would at first be thought advisable, as with attention these will make stronger plants than larger ones, which are more likely to receive a check. The soil requires constant striring, owing to the packing caused by the rains and for the eradication of weeds, which are now very troublesome. All plants should be kept free of dead and decaying matter.

VEGETABLE GARDEN.

Turnips, carrots, cabbages, lettuce, etc., may be sown for carrying on during the winter months. Potatoes may be planted this month for keeping through the winter. Weeding and cultivating between the rows should be continually carried on.

POULTRY.

All houses must be absolutely watertight, the floor raised well above the level of the surrounding ground, thus preventing water seeping in and making it damp. The birds themselves should not get wet, and no pools of water should be seen in the runs.

Foodstuffs must be kept absolutely dry, otherwise they will become mouldy and sour, causing disturbance of the intestinal tract, illness, and perhaps death; certainly a diminution in the number of eggs.

Some of the birds will now be in moult. To get them through it quickly give more sunflower seed, some monkey nuts, plenty of green food, especially cabbage, kale, etc., plenty of milk or some meat, a little sulphur in the dry mash (one teaspoonful to 1 lb.); also stew two dessert spoonfuls of linseed in a pint of water to a jelly, mix this to a crumbly consistency with mealie meal or bran and give about one dessert spoonful to each bird daily. Keep the birds dry during the rains, otherwise the egg output will decrease.

Do not hatch any more turkeys till after the rainy season is over. Turkeys should not be penned up, but allowed on free range.

Ducks must be treated in almost exactly the reverse manner to what turkeys are. They should be kept in a small run; nearly all their food should be wet mash, bran, pollard, mealie meal, meat meal and milk, as much as they will eat three times a day, *i.e.*, they should practically be allowed to spend their existence eating and sleeping. Big duck breeders often give a fourth meal by lamplight at 10 p.m., and the first meal is given at sunrise.

Cleanliness Aids Insect Control.

Mycological Notes

14. SEASONAL NOTES ON PLANT DISEASES.

By J. C. F. Hopkins, D.Sc. (Lond.), A.I.C.T.A., Senior Plant Pathologist.

Now that the planting season is with us, the lands are all prepared, implements renovated and adjusted and a feeling of optimism pervades the countryside. Already maize, potatoes and tobacco are appearing through the soil and the greenery of spring is enlivened by brilliant floral patches in the veld. The prospects for the coming season are good. We are all experiencing that feeling of uplift which comes with the first rains, so let us do our utmost to retain that feeling and stave off the black depression which so frequently follows upon cheerful optimism.

Let us consider in what ways this can be done. First of all we will assume that every grower has treated his maize seed before planting (E. and O.E.), so that we can look forward to good stands of young plants. In most cases that means one bag per acre already in the crib. Now, how about the refuse from last year's crop? Is it still lying in lands which are going into fallow this season? Yes, it is, at least a good deal of it is and can be seen protruding from the green vegetation which has not yet completely covered the lands. Eventually the old stalks will disappear from the eye of the casual observer, and being out of sight can be conveniently put out of mind. This mental exercise will not, however, get rid of the Diplodia germs, or spores, awaiting the opportunity to perpetuate themselves on the cobs and stalks of the new crop, which we now regard so optimistically. It is still not too late to plough in this infected trash.

Now there are many other crops which benefit from seed disinfection, but two, namely, beans and monkey nuts, should be treated this season. It is not perhaps known that probably

all Canadian Wonder bean seed in the Colony is infected by bacteria causing the "halo blight," which appears as yellow blotches on the leaves and finally destroys them. Affected plants die down early with a consequent short yield of pods. The pods themselves become infected and so the disease is perpetual from year to year. It has been shown in several countries that seed disinfection reduces the losses from "halo blight," so that if Canadian Wonder beans are to be planted, the seed should be treated. The dose is $6\frac{1}{4}$ ozs. to the bag. A new variety of bean known as Black Wonder has become popular in the last few years. It is very resistant to halo blight and is an excellent yielder. It has been tested at the Plant Pathology laboratory with good results.

Monkey nut seed is often infected by fungi and after the heavy rains of last season the amount of infection is this year higher than usual. Germination has been considerably improved by seed disinfection with mercury dusts in trials made in Salisbury, and it is recommended that all farmers who intend to plant nuts this season shoul dtake this precautionary measure. The dose is the same as for maize.

Market gardeners who lose many of their peas from wilt and foot rot during the rains will find that seed treatment is effective in reducing their losses. In New Zealand it has recently been shown that pea seed germination can be increased by about 14 per cent. by the use of mercury dusts. The dose is the same as for maize and beans.

Finally, it is now known that nearly all plants benefit from seed treatment by modern fungicidal dusts. Cotton, cabbages, cauliflowers, carrots and onions are a few that have been tested scientifically, whilst reports from farmers indicate that most vegetables and flowers respond to treatment. The method with small packets of seeds is to put in pinch of dust in the packet, shake well for a minute or two and remove surplus dust by winnowing. Treatment can conveniently be done just prior to sowing and the cost is negligible.

Don't forget that tobacco seed-beds need spraying right up to the time the plants are pulled. Spraying in the field at three, four and five weeks after transplanting is now the latest fashion.

Some "Seedy" Maxims

1. Like tends to beget like; sow good seed.
2. Any old seed is dear at any price.
3. Good seed is cheap at a good price if obtained from a reputable grower.
4. REMEMBER, a supplier's reputation dies with his seed if its poor and diseased.
5. CHEAP and poor seed produces poor stands and low yields.
6. Poor seed means wasted land and wasted labour.
7. Poor seed makes the poor farmer poorer.
8. Sow GOOD seed in GOOD soil and reap GOOD CROPS.
9. Seed treatment makes GOOD seed produce better crops.

CLEANLINESS AIDS INSECT CONTROL.

Nineteenth Annual Report

DIVISION OF FORESTRY FOR THE YEAR 1938.

INTRODUCTION AND SUMMARY.

By E. J. Kelly Edwards, M.A., Dip. For. (Oxon.),
Conservator of Forests.

The year 1938 will probably be notable as marking the beginning of a new era in the recognition of the value of the Colony's indigenous forests.

In the first place a Commission was appointed to enquire into and report upon the extent to which the natural resources of the Colony are deteriorating or being wasted through various causes and the methods by which such deterioration and waste may be prevented and the natural resources preserved. The findings and recommendations of the Commission, which is still carrying out its investigations, are awaited with the keenest interest.

Secondly, the vigorous campaign launched by Government against uncontrolled veld fires received enthusiastic response from all sections of the community. Apart from the benefits in the matter of water and soil conservation which will accrue from an active continuation of this policy the gain in timber and other forest produce will be incalculable.

Thirdly, the decision of Government, communicated to timber concessionaires, to uphold the method of sale of timber in the round instead of on the sawn product and to limit the annual or periodic cut in such a way as to ensure both a sustained yield and the continuance of the timber industry will have far-reaching effects, firstly on the valuable Umgusu (*Baikiaea plurijuga*) forests of Matabeleland and secondly on the future yields from other State forests and plantations.

Kalahari Sand Forests.—Instilled with further keenness as a result of this decision, the Forest Service was able to

push rapidly ahead with the all-important enumeration surveys of both exploited and unexploited areas of umgusu forest, and it is gratifying to record that almost 500,000 acres were covered by the various field parties.

By the middle of the present year it is hoped that the whole of the acessible umgusu forests on Crown land will have been covered by these stock-taking surveys and that by the end of the year the data will have been co-ordinated in the framing of a plan to manage these forests on the principle of a sustained yield.

At this stage it is already clear that a curtailment of the past rate of cutting will be necessary, but with the co-operation of the timber industry it is hoped that the permissible yield will not be below the requirements of an economic saw-mill unit.

Fire protection operations are essential to the survival of these forests, and the Division was again successful in protecting 590,000 acres and in having the good record of only 5,000 acres, or 0.84%, of the protected area accidentally burnt. In accomplishing this, control-burning was used on an extensive scale.

Stapleford Forest Reserve.—The fire protection scheme at this Station, on which coniferous plantations predominate, was reviewed and it was considered advisable to supplement the existing layout by providing more roads and paths and fireguards of cleared and live belts at the sacrifice of a portion of the year's planting programme.

The incidence of the rains of the 1937/38 season was generally unfavourable for planting with the result that fairly heavy blanking operations were necessary. However, with very good rains at the end of the year much leeway was made up both in blanking and extension and in consequence the very creditable total of 608 acres planted was achieved.

The area of plantations is now 5,045 acres, of which 4,857 acres are made up of conifers.

Many of the plantations are now in urgent need of thinning and pruning and a comprehensive programme is contemplated during 1939.

Mtao Forest Reserve.—The 1937/38 planting season was even more unfavourable at Mtao, and extensive blankings and re-plantings had to be undertaken during the present season.

The area afforested during the year amounted to 162 acres, of which 59 acres were of conifers.

A general stock-taking was made in the form of re-surveys and enumeration surveys, and as a result the total planted area now stands at 2,195 acres, of which 1,009 acres are conifers.

Sales of timber, which totalled over 13,000 cubic feet, showed a decrease of 7,000 cubic feet compared with the previous year, due probably to less building activity in Bulawayo.

Salisbury Forest Nursery.—The Nursery had a very successful year and sales constituted a record. The total revenue amounted to £2,908, of which £2,004 represented cash sales and £904 Free Issues to Government Departments and others.

Over 378,000 plants were disposed of by the Nursery. The number could have been increased but for the shortage of transplant tins, which was severely felt and which it was necessary to overcome in part by the expensive purchase of tin plates.

One thousand nine hundred and fifty persons visited the Nursery during the year.

Forestry in Native Reserves.—One Forest Officer was again seconded to the Native Department, to supervise exploitation of timber and tree planting in native reserves. Preliminary reconnaissances were carried out in four reserves and eleven others were visited.

An important step was initiated by the definite reservation of forest areas in one reserve. The purpose of these forest areas, which will be extended to other reserves, is the preservation of vegetation in catchment areas and along certain stream banks for the conservation of soil and water. Certain areas will also be set aside for the controlled supply of forest produce to the native inhabitants.

Arrangements are now being made for the training of native foresters who will be posted to the reserves for the general supervision of forest areas and the carrying out of tree planting and protection.

European Unemployment Relief in Forestry.—At Mtao the Chaka Forest Nurseries continued to employ elderly or partially disabled Europeans under the supervision of a Forester and a Welfare Officer. An average of 46 men were thus employed, and during the year they were responsible for the raising of over 450,000 transplants.

At Stapleford the European Labour Afforestation Camp functioned smoothly. The average number of men provided with employment increased to 16 as compared with 12 the previous year. The value of work performed in such operations as road construction, thinning and pruning, was assessed at the cost of native wages, *i.e.*, eightpence per working day. This cost formed a charge against forestry, while the balance of the wages was met by the Department of Internal Affairs. The average wage received was 4s. 3d. per day.

Game Reserves and National Parks.

The Wankie Game Reserve continued to increase in popularity and there were 262 visitors, of whom 113 made use of the rest camps. The average amount of game seen during any one month varied between 1 and 2 head per mile.

Thirty miles of new road were roughly constructed, while the existing 177 miles of road were improved and kept in repair. Four new rest huts were constructed.

Considerable improvement in the potential water supplies was effected by the Irrigation Division, which completed the construction of three dams during the year.

The 1937/38 rainy season was extremely poor and only two natural "pans" retained water throughout the year. All "pan" supplies which were augmented by windmills and boreholes held out during the dry season, and this reacted favourably on the game population in the northern portion of the reserve. In the southern, less fortunate part, mortality, particularly among wildebeest, was very severe.

The Victoria Falls Reserve continued to be administered by this Division on behalf of the Monuments and Relics

Commission. Tourists are visiting the Falls in increasing numbers, and it is estimated that visitors totalled 9,500 during the year.

Considerable improvements are now being effected, notably in the building of a Native Village to house local employees and immigrant labour.

A new all-weather camping ground was prepared and the question of providing cheap accommodation to visitors is under consideration.

Rhodes Inyanga Estate.—The popularity of the Estate as a tourist and mountain holiday resort is growing steadily, and it is noteworthy that large areas of land in the vicinity changed hands both in the form of small plots for holiday purposes and larger tracts for sheep farming and cattle ranching.

The hotel was renovated and was well patronised and a fourth rest camp was almost completed. Ten miles of new road were opened to places of interest and small plots of trees planted to improve the amenities.

Mr. C. Sutton, Inland Fisheries Officer for Natal, furnished a valuable report on the existing and potential trout waters of the Estate as well as of other parts of the Eastern Border. Mr. Sutton confirmed the intention of the Government to stock the Pungwe River system with Brown Trout and advised that in general the brown would be more suitable than rainbow for most Eastern District waters.

Rainbow trout fishing opened on the 1st October and results have proved satisfactory, the average weight taken being approximately 1¼ lbs. for the present season.

An important feature of the year's work was the completion of a census of all native tenants on the Estate, which is over 100,000 acres in extent. Full information was obtained as to the distribution of the kraals, the numbers of all livestock, the extent of arable areas and the methods of cultivation. A comprehensive plan is now in preparation to control the incidence of grazing and the methods of cultivation to obviate wastage of the natural assets of the Estate.

Particular mention is made of the excellent response of all members of the staff during a year of unusual shortage

occasioned by resignations, illness, secondments and long leave.

I. CONSTITUTION OF STATE FORESTS.

1. **Forest Reserves.**—No additions or excisions were made during the year and the total area remained at 900,374.05 acres as follows:—

Name of Forest Reserve.	Area Acres.	Brief Description.
Reserved Forests.		
Stapleford Forest Reserve	60,863.20	Situated in the mountain grassland areas of the Eastern Border. Average rainfall 69 inches per annum, mainly in summer with mists in winter. Soil deep, mainly of granite origin. About one-fourth of the area between altitudes of 5,000 to 6,000 feet is well suited to the growing of such conifers as *Pinus patula, P. caribaea, P. taeda, P. palustris, P. longifolia, P. radiata, Cryptomeria japonica* and others.
Mtao Forest Reserve	15,498.37	Situated in the Midlands near Umvuma. Topography very flat. Altitude about 4,850 ft. Average rainfall 27½ inches in summer. Soil very deep Kalahari Sand carrying thick *Brachystegia-Isoberlinea* woodland. Great depth of soil compensates for comparatively low and irregular rainfall. Suited to the growing of many species of *Eucalyptus,* chiefly *E. punctata, E. rostrata, E. tereticornis, E. saligna* and *E. maideni* and such conifers as *Callitris calcarata, C. glauca, Pinus longifolia* and others.
Gwaai Forest Reserve	299,500.00	These areas are almost contiguous and are situated on the railway line between Bulawayo and Wankie. Flat country with average altitude of about 3,350 ft. Rainfall 20-25 inches per annum. Soil mainly very deep Kalahari Sand, carrying the Umgusu—*Baikiaea plurijuga* woodland type with which is associated *Copaifera coleosperma, Pterocarpus angolensis, Ricinodendron rautanenii* and others. The areas are managed for the production of indigenous timber and no exotic trees are planted.
Ngamo Forest Reserve	291,000.00	

Name of Forest Reserve.	Area Acres.	Brief Description.
Salisbury Forest Nursery	112.48	Situated on the outskirts of Salisbury. Altitude 4,900 ft. Rainfall 32 inches. The nursery is used for the trial of new species of trees and ornamental shrubs and for the production of trees and shrubs for sale to the general public.
Total Reserved Forests	666,974.05 acres.	
Unreserved Forests.		These areas contain the Umgusu woodland type and subject to favourable results from recent enumeration surveys will be brought under forest management in conjunction with the Gwaai and Ngamo Forest Reserves
Bembesi Forests	108,960.00	
Inseze Forests......	86,240.00	
Fuller Forests	38,200.00	

Total Unreserved Forests .... 233,400.00 acres.

Grand Total Forest Reserves...... .... 900,374.05 acres.

2. **Game Reserves and National Parks.**—The areas under the administration of the Division are:—

Wankie Game Reserve	3,290,880 acres.
Kazuma Pan Game Reserve	48,640 acres.
Victoria Falls Game Reserve...... ...... (includes Victoria Falls Reserve 22,350 acres.)	134,400 acres.
Matopo National Park	224,000 acres.
Total	3,697,920 acres.

The Rhodes Inyanga Estate, 101,040 acres in extent, is held in trust by the Government and administered by the Forestry Division.

3. **Demarcation and Fencing.**—The placing of beacons on the south-eastern boundary of the Gwaai Forest Reserve was completed by a land surveyor, and a survey was made of that portion of the Gwaai River which forms the eastern boundary of the Ngamo Forest Reserve.

At Mtao the remaining portion of the Reserve boundary common to the farm Van Zyl was fenced for a distance of 1¾ miles in conjunction with the owner of the farm.

(*To be continued.*)

Feeds for Poultry and How to Use Them.

By G. H. Cooper, Assistant Poultry Officer.

During recent years considerable work has been done and knowledge gained in the use of many feeds for poultry. Most of this work concerns the rearing of chickens and feeding for egg production. Other classes of poultry have had less attention paid to them and also much work in connection with digestibility trials with poultry remains to be done. However, it is felt that a comprehensive list of foodstuffs and the latest knowledge applied to their use for poultry feeding will be of great use to farmers in Southern Rhodesia. Special attention has been given to the use of Rhodesian experience and analyses of feeds where available.

THE FEED STUFFS.

Barley.—This grain is not used to any extent in Southern Rhodesia. Where it is available it may be used, but is not so palatable as maize or wheat. Good heavy grain may be used as a substitute for maize, especially in fattening rations. It may be fed as a scratch grain or in the form of ground barley in the mash, where it may be useful to add variety.

Beans.—Various types of beans are occasionally fed to poultry usually as cracked beans as a grain or in the mash as bean meal. As beans in general are not considered very palatable to poultry they should probably be fed as bean meal in the mash and not form more than 10% of the ration. Velvet beans have been shown to be unsuitable for poultry feeding. If cull beans are available they may be utilised by cooking, which will improve the palatability. The cooked beans should be mixed with a little mash and fed as a wet mash.

Buckwheat.—At present this feed is not extensively grown and it is not eaten readily by fowls. As buckwheat

middlings it may be fed in the mash, but the hulls must be sifted out. When fed to poultry it produces a white flesh and light coloured yolks.

Cotton Seed Meal.—Has been used for poultry feeding with somewhat contradictory results. It is generally accepted as being not a very desirable feed for poultry. It is high in protein and should be fed where used as a protein supplement to the cereal grains. If fed in large amounts it may prove injurious. Not more than 10% of the mash should be fed in the ration.

Cowpeas.—This legume contains a large amount of protein with the essential amino-acids which are lacking in the grains; this is true of most of the leguminous seeds. Cowpeas may be somewhat unpalatable to poultry, but if the birds are accustomed to them whilst young they may be fed to advantage either as a grain or a mash ingredient when ground. They should be used as an additional protein supplement to the cereals. They are usually too expensive for feeding.

Gluten Feed.—Consists of the gluten and bran of maize. It is high in protein but a similar quality to the proteins of the grains and therefore unsuitable for use in mashes as a protein supplement to the cereals.

Hominy Feed.—Consists of the bran or hull, germ and some of the starch. Its composition is similar to maize but is higher in minerals and fat. It is an excellent feed for poultry, but is rarely on the market in this country.

Kaffir Corn and Kaffir Corn Meal.—May be considered only fairly palatable and nearly the equal to maize in feeding value. It has a composition between wheat and maize. It may be used whenever available.

Maize.—The most valuable feed for poultry owing to its high digestibility and palatability. It is produced on nearly every farm and is always available. It cannot be fed, however, without supplements of proteins from other sources. Yellow maize is preferable, as it alone carries Vitamins A and E and is more palatable than white maize. Also it gives a deep yellow colour to the yolk of eggs, and in yellow skinned

breeds to the skin pigments. Flint maize has usually a smaller grain and need not be cracked for poultry feeding, but may be soaked for 24 hours with advantage. It is also somewhat higher in protein than dent maize. The best maize to feed as grain, therefore, is a fairly small yellow flint which is fed whole, preferably after soaking. Cracked maize refers to the grain cracked or broken for grain feeding. There is a certain amount of loss and extra cost in grinding which does not improve the digestibility of the whole grain, therefore it should be avoided unless the grain used is too large, when kibbling is necessary.

Maize meal.—Serves the same purpose in the mash as the whole grain does in the scratch feed. It should be ground fairly fine or otherwise the birds will tend to take it from the mash mixture owing to its palatability. Yellow maize is again preferred. Maize must be fed with discretion and not heavily to old birds, especially the heavy breeds or to birds which are not producing heavily. Birds just through the moult should not be heavily fed on maize before laying. When there is a tendency to thin shelled eggs or cases of prolapsus, it should be fed very lightly. It has a tendency to produce an accumulation of yellow fat internally, but when fed in conjunction with other feeds is the best of all cereals for egg production.

Maize and Cob Meal.—Usually known as corn and cob meal, it is made by grinding the grain and cob together. If the grain is shelled the mixture to be used is four parts of maize meal to one part of cob meal. The cob has little nutritive value, but may be added for bulk in some mashes. Too much cannot be fed.

Maize Germ Meal.—Usually available and may be used for a portion of the maize meal in rations where it is necessary to bring up the protein content slightly without increasing the animal feed. It is slightly higher than maize meal in protein.

Millet Pearl.—Known in Rhodesia as "N'youti" or "Munga," it is used very extensively as a chicken feed and for laying hens. This variety of millet has not so hard a shell as many others and is more desirable. It is supposed to

have a beneficial action upon the kidneys. It is very palatable and so should not be fed in too great quantities, especially to chickens, as it is likely to cause crop trouble. It has a large germ and probably carries enough Vitamin A to support nearly normal growth, which is important when white maize is fed and green feed is lacking.

It is similar to wheat in composition. Ground into a meal it may with advantage form part of the mash feed. As a grain it is very useful to induce exercise, as it is small and eagerly sought. For poultry feeding it is considered as valuable as yellow maize. It carries more protein than maize.

Milo.—May be considered similar to Kaffir corn but not of quite as high feeding value or palatability.

Oats.—The value of oats depends upon its weight. A light oat, which is mostly hull, is not suitable, and unfortunately most oats grown in this country are considered light. Heavy clean oats or oatmeal is greatly relished by chickens and is a very desirable feed. A small portion of oatmeal or Sussex ground oats is frequently fed to small chickens, but is usually too expensive to feed otherwise.

Pea.—Field peas are usually too high in price to be used as a poultry feed, but pea meal is an excellent feed for all classes of stock, being high in protein and of the correct kind to balance the cereal grains.

Peanut Meal (with shells, not extracted).—This feed consists of the ground kernels and shells and may be successfully used as a mash ingredient for all classes of poultry. It is fairly high in protein, and very high in fat, which is its chief disadvantage. It may comprise up to 20% of the mash for laying hens without causing trouble; however, the mash should contain other feeds low in fibre and oil. It is not so good a feed as the extracted peanut meal, but where peanuts are grown on the farm it may be used with greater economy perhaps.

Peanut Meal (with kernels only).—The ground kernels form a similar feed to that, including the shells, but contain

more protein and more fat with less fibre. This feed may be used in small quantities in the mash, but should be used with care.

Peanut Meal Extract (oil extracted meal from unshelled nuts).—This feed has been shown to be an exceedingly valuable protein supplement feed for the cereal grains, being high in protein, carrying the desirable amino-acids. It may be used for all classes of stock and may replace entirely or in part the usual protein rich feeds of animal origin, though it is considered best to use some animal protein feed in conjunction with it. It largely depends upon the current prices what amount of animal feed will be used. When used as the sole protein rich supplement in a ration the necessary minerals must be added by the use of bone meal.

Pollard.—The by-product of wheat in the production of flour. It is similar to middlings, shorts, thirds, etc., and normally contains fine bran and some flour. It is one of the most widely used feeds in all mashes and is an excellent feed, especially when combined with wheaten bran. Too much in the mash should be avoided as it is high in gluten and may form a sticky mass in the mouth and interfere with heavy mash consumption. It must be balanced with proteins from animal or suitable vegetable sources. It should form a large part of the cereals in all mashes.

Rice.—Is not used to any extent, but may be used as a fattening feed, being high in carbohydrates. It may be used in the grain portion of the ration. Rice by-products may be used to a limited extent only, because of a high fat content.

Soya Bean Meal (oil not extracted).—The soya bean ground into a meal. This feed is high in protein and fairly high in fat and may be used in a mash in a similar capacity as peanut meal (not extracted), but is preferred to the latter because of its higher protein value and lower oil content. It should become increasingly popular when this excellent legume is grown more extensively. It promises to be one of the most useful feeds rich in the proteins necessary to balance the cereal grains which will be available to the farmer without undergoing any manufacturing process. It may be recom-

mended as a protein supplement to the cereal grains and may substitute most of the purchased animals protein feeds if necessary. When ground, the seed should be mixed with a certain proportion of maize owing to its oil content which makes grinding otherwise difficult.

Soya Bean Oil Meal (fat extracted).—Owing to the fact that other products such as peanut and cocoanuts have a higher oil content than soya beans they are not used extensively to-day for oil production. Where they are, however, the resulting cake with the oil extracted is an excellent feed for all poultry and is better than the soya bean meal without the oil extracted. It is very high in protein and possesses all the attributes of the best protein rich supplements for the cereal grains. Where procurable at reasonable prices it may be used with advantage as a protein feed, with the addition of the necessary minerals.

Sunflower Seed.—This seed is extensively used in the grain for adult birds and may form 10% of the grain ration at all times and more especially during moulting periods. This seed is high in oil and must be used with discretion if peanut meal or soya bean meal are included in the mash, as too high a percentage of oil in the ration may cause digestive disturbances. The small black variety is most commonly used. It carries a reasonable amount of protein and is high in fibre.

Sunflower Head Meal (without seeds).—This feed consists of the ground up sunflower head after the seeds have been thrashed out. It is becoming popular in certain areas where wheaten bran is expensive. It is used as a bulky feed and may replace up to 20% of the wheaten bran in a mash. It has been used experimentally to supply the entire bulk in a ration and with apparent success. It is high in fibre.

Sunflower Head Meal (with seeds).—This feed is similar to the last named, except the seeds are not thrashed out before grinding. It is even higher in fibre but also higher in protein and oil. When these feeds are used no other fibrous feeds should be included and too much of these feeds should not be fed. A better grade of meal is produced if ground finely in a hammer mill.

Wheat.—The price of wheat usually makes it too expensive to use as a poultry feed here, but it is one of the best grain feeds for all classes of stock, being very palatable. It may always be included in the grain ration.

Wheat Bran.—A by-product of flour manufacture consisting of the outer layer of the wheat kernel. It is probably the most popular mash ingredient for adding bulk to the ration. It is excellent for mixing with cereal meals, though its protein is deficient and does not help to balance that of the other cereals. It is high in ash, has a cooling effect upon the digestive tract and is slightly laxative. It seems it is fed more for its physiological effect than for its feed value.

Wheat Feed.—When wheat is ground into a meal it forms an excellent ingredient for the mash and may partly replace both the bran and pollard in the mash if used, otherwise it may be used as a feed in any mash according to its value as shown in the table of feeds.

Wheat Screening.—This feed, consisting of shrunken and cracked wheat, may often be purchased at low prices, and if it is free from contamination with weed seeds and dirt is an excellent grain feed for all poultry. Actually shrunken wheat has been shown to be higher in protein than the full plump wheat. Wheat screenings may be ground into wheat feed if desired.

FEEDS OF ANIMAL ORIGIN.

These feeds are used chiefly as sources of proteins to balance the carbonaceous feeds, as birds are omnivorous at least one feed of animal origin in the ration is usually recommended, but more than 6% of animal protein feed in the total ration is wasteful and injurious.

Blood Meal.—A by-product of the slaughter house, it is always available and is probably the cheapest form of protein, of which it has a very high percentage. However, all authorities are agreed that it is unsuitable for poultry and is not generally recommended for this reason. A small proportion of the protein feed may consist of blood meal if desired, but more than 5% of this mash is not advisable.

Blood (dried).—This product is high in protein but lower than commercial blood meal in this respect. The same remarks as to unpalatability apply, however, but with perhaps less emphasis.

Blood (fresh).—Where this is available it may be used with advantage, and it may often be obtained for the taking away. Fresh blood is palatable and high in protein. It should be fed by mixing with equal parts of wheaten bran and maize meal to form a wet mash. Do not feed it as a liquid to birds as it will make a nasty mess and often leads to feather picking or toe picking and cannibalism.

Bone Meal.—This product is fed more for its phosphate of lime content than for its protein content, though it has an appreciable amount of the latter. It is therefore more of a mineral supplement, and as such should be used in all mashes for all classes of stock. About 2% in the mash is sufficient.

Bone (fresh cut).—Fresh bones may often be obtained for next to nothing, and when cut in a green bone cutter form a palatable and highly nutritious feed, rich in mineral matter and protein. It should be fed fresh and not more than 1 oz. per fowl every other day given, otherwise digestive trouble may follow from too heavy feeding. If properly dried in the sun it may be kept satisfactorily. It should not be fed if at all tainted. It fits best into general feeding practice if used as a tit-bit occasionally to the birds, especially when it is necessary to encourage egg production.

Buttermilk.—This is a very excellent feed for all poultry, and more especially small chickens. Unless fed *ad lib.* without water not sufficient can be digested to balance the cereal grains, and therefore half the required amount of other animal protein feed is used in the mash. It is similar to separated milk in feeding value. Dried and semi-solid buttermilk are not available as yet, but are considered one of the very best protein supplements in other countries. Be sure that buttermilk has not an excess of common salt in it before feeding.

Crayfish Meal.—A feed made from grinding the shells of crayfish is fairly high in protein and exceptionally so in desirable mineral substances. It may be safely used as a

protein supplement to the cereals where procurable at a reasonable price. It should be purchased on the value of its protein content.

Fish Meal.—A concentrated protein rich feed of high quality; is excellent for balancing the carbonaceous feeds. It is usually higher in protein than meat meal and also higher in price. It has no advantage over good meat meal. It is often not procurable and then difficulties arise.

Locust Meal.—Dried locusts ground to a meal form a very desirable protein rich feed for poultry. Wherever available it should be used in the place of other purchased protein feeds such as meat meal. Experiments have shown that there is no danger in utilising locusts as feed which have been killed by spraying with Government formula arsenic sprays.

Meat Meal (high grade).—Pure meat meal of high grade containing no bone, hoof, hair or other contamination is one of the best by-products of slaughter houses for use in poultry rations as a protein rich feed. It is high in protein containing the amino-acids deficient in the grains.

Meat Meal (average 50% protein).—This product is most commonly used and is the usual feed supplied when "meat meal" is purchased. It is similar to high grade meat meal but contains more undigestible materials and less protein.

Meat and Bone Meal.—Meat meal with a varying amount of bone meal is a good feed for poultry, carrying less protein than meat meal. Meat meals generally should be purchased on the guaranteed protein content. A good sample should be free from hair and gelatinous substances and have an odour of cooked meat. Good samples are produced locally, and this feed should form the animal protein rich feed in this country as a general rule.

Meat (fresh).—Like fresh blood, meat may be used by mincing and mixing with mash to form a wet mash. Under no circumstances should putrid meat be used. It is best fed like green bone as a tit-bit, on the average size poultry farm.

Meat (dried).—When fresh meat is minced and thoroughly dried in the sun it may be used in the mash in the place of meat meal and is equally as good. It may be dried in small pieces the size of a wheat grain and fed as a

scratch feed when extra protein is considered necessary. In this way meat may be preserved on the farm and made use of when needed. When cattle are dying from drought, they may be utilised in this manner. Meat from antelope, donkeys, horses, etc., is equally good, but must be fresh and free from taint.

Milk (separated).—Whole milk is seldom fed to poultry and, indeed, it is unnecessary, as separated milk is actually better, containing the same protein and less fat. Separated milk may perhaps be considered the very best protein supplement to the cereal grains. Where it is used no other minerals are required except lime. Skim milk may be fed to all classes of poultry and is especially valuable for young growing stock. To baby chicks it should be fed sour, otherwise they may be upset, or even die, from indigestion due to the fact that at first the chicks lack a lactose digesting enzyme which develops later. It should always be fed in the same condition, and because of this fact and also that it is difficult to keep sweet in summer, it is the best policy to feed it sour at all times. The sour skim milk should be thoroughly stirred before being fed as a drink or used to mix a wet mash. If desired the curds may be drained and fed in the form of cottage cheese mixed with mash. It has been shown that sour skim milk fed *ad lib.* without water to drink, together with cracked maize, forms a balanced ration for both growing chicks and laying stock. Skim milk and butter milk may be mixed for feeding and are of equal value. They both contain Vitamins A and G.

Whey.—Milk whey is low in protein because of the loss of casein in the making of cheese. It is therefore not a substitute for other animal proteins, but it contains the lactalbumin protein present in milk which is so valuable for growth. It also contains minerals and vitamins. Whey should always be used for poultry feeding where available, though the animal protein in the mash should not be reduced more than 2 or 3%.

DRY GREEN MEALS.

The dry green meals are fed as a source of Vitamin "A" and are of great importance in this country, where at times succulent green feeds are unobtainable.

Lucerne Meal.—The best samples are made from the leaves only for young lucerne stems, but the usual meal purchased is made by milling hay from the crop. The value of this feed may vary considerably according to its quality. The essentials in a good quality meal may be summarised as (1) That the meal is a good bright green colour; (2) that it contains a minimum of stems; (3) that it has not been adulterated with a poor grade of hay. Lucerne meal is high in fibre and cannot be fed in too large a quantity. It contains some lime and protein, but is chiefly fed for its Vitamin content, of which it contains all those of importance. Other legume hay meals of good green quality may be used similarly to lucerne meal. Seven to 10% green leaf meal in the mash is sufficient.

Sunflower Leaf Meal.—The leaves of the sunflower plant if stripped at intervals, dried and ground into a meal, may be used in the mash in the same way and for the same purpose as lucerne meal. It is likely that the sunflower leaf meal is equally as good as feed from the Vitamin content point of view of lucerne meal. The meal should be green and must be dried carefully out of the sun and dew to preserve the Vitamins. It contains less fibre than lucerne meal if the thick ribs of the leaves are not used. The quality of sunflower leaf meal is gauged by its green colour and freedom from thick leaf ribs and stems. It is used largely in Rhodesia in the place of lucerne meal, as the sunflower can be grown anywhere and provides other useful feeds as mentioned elsewhere.

SUCCULENT GREEN FEEDS, ROOTS, ETC.

Succulent green feed plays a most important part in poultry feeding. Its value lies not in its feed value as expressed in proteins or carbohydrates but in its vitamin content and its other health promoting properties on the digestive system, such as distension of the intestines and variety, thus enabling the bird to make greater use of other feeds. Not least of its value lies in its promotion of good health, thus affecting a great saving from disease and loss of products. It has a cooling effect on the system which is very beneficial in a hot climate, and it assists very materially in the more economic production of both eggs and table birds. Most types of succulent green feed should be finely chopped and fed fresh to the birds in troughs or wire baskets.

Cabbage.—The leaves of cabbages or small unmarketable heads make an ideal succulent green feed for poultry and one that is greatly relished. The green leaves contain more Vitamin A than the white portion.

Cactus, Spineless.—In times of drought or in districts where it is difficult to grow other greens, spineless cactus may come in very useful indeed. As a standby some should be grown on every farm. The leaves are cut into strips with a knife and the birds, when accustomed to it, will eat all the succulent feed from the centre. It most likely carries Vitamin A.

Carrots.—The best variety to grow is the yellow carrot, which has been shown to carry Vitamin A, where as other varieties do not. These carrots are the best root crop available to substitute for fresh greens. They are very beneficial for turkeys. Yellow carrots should be chopped into small chunks for feeding.

Grass.—Green grass is the natural feed for poultry, and when young and succulent is very beneficial. Free range on green grass is ideal. Green grass contains all the vitamins of importance.

Lettuce.—For chickens this succulent green feed is excellent, as it is soft and easily digested. All classes of stock greatly relish it. It contains the essential Vitamin A and may safely be used wherever available.

Lucerne.—Like green grass lucerne contains all the known vitamins and is one of the most widely used green feeds. It also contains some protein and lime which is essential for all poultry. It is greatly relished and can hardly be bettered as a succulent feed for all classes of stock.

Mangels.—Where available mangels may form a useful substitute for greens. They are low in Vitamin "A," however, so this should be supplied by yellow maize or other feed. Mangels may be stored and when fed should simply be cut in half lengthways and the birds allowed to pick out the succulent feed.

Melon, Cattle (Majorda).—This feed is grown on practically every farm, and in conjunction with spineless cactus may well replace the use of root crops as succulent feeds in this country. Melons being green probably contain Vitamin "A" in sufficient quantity. Where no succulent green feed is available they may be cut into quarters and placed for the birds to help themselves. Keep out of the hot sun. Melons, when cut, soon become sour if not consumed and may cause digestive trouble, so they should be fed fresh daily and all not consumed taken away at night. The seeds need not be taken out, they will do no harm. They can be stored for months, but should not be fed if bruised or decayed.

Oats, Green.—Where available green oats or green feed from other grains may be used for poultry feeding. They all contain vitamins. They should only be fed when young and succulent and not when fibrous and old. Green feeds of this type should be cut in a green food cutter.

Oats, Sprouts.—Where absolutely no succulent green feed or dry leaf meal is available oats may be sprouted in an oat sprouter and fed to poultry as a succulent and vitamin feed. The sprouts should be fed when green and about 3 inches high. Feed one square inch of the germinated oats and green shoots per hen. Munga sprouts may be used in the same way.

Onions.—As a succulent green feed onions and green onion tops may be fed to poultry and have a beneficial effect on the system. They are especially valuable for brooder chicks on cold days or when they need a little cheering up. Too much must not be fed to laying stock, otherwise they may taint the eggs. Self-multiplying onions are the best to grow.

Potato.—This crop is not generally fed and is not a vitamin supplement of any value. Where it is desired to use them they should be boiled and mixed with mash. They are a fattening feed and should not be fed to any extent, except for that purpose.

Pumpkin.—Like the melon, this feed is grown extensively and may be used as a succulent feed. It contain Vitamin "A." The same remark apply to pumpkins as for melons.

Rape.—Where it is grown rape and kale form excellent greens for poultry. Rich in Vitamins "A," they may add variety to the green food rations. Containing more green leaf they are preferable to cabbage.

Sunflower Leaf.—The leaves of the sunflower plant may be plucked, chopped and fed to poultry as greens. Being somewhat coarse they are better suited to adult stock. They will contain Vitamin "A."

Swiss Chard (Spinach Beet).—This crop is an excellent one for poultry. It is a perennial and a heavy cropper. The leaves only are fed and form a soft succulent green feed rich in Vitamin "A." It is an excellent crop for winter greens and is most palatable.

Other Greens.—If birds will eat the chopped green food almost any greens are suitable from a Vitamin "A" point of view. To get birds used to a change in greens mix with a little wet mash for a while. At times such greens as "M'sasa" tree leaves, cassava, mulberry, Belhambra, paw-paw and willow leaves have been fed and are certainly better than no greens at all.

(*To be continued.*)

IT'S A WORKER.
Don't Brood or be Stung
but
Comb your Farm for Refuse.

Compost.

By S. D. Timson, M.C., Assistant Agriculturist.

(Concluded.)

SUGGESTED MODIFIED TECHNIQUE FOR COMPOSTING THE SUNNHEMP CROP.

The simple technique advised is given below followed by a more detailed explanation.

(1) Mow the sunnhemp at 18 to 20 weeks from germination.

(2) Sweep and drag it up to narrow moveable kraals on either side of the field along the headlands.

(3) Fork the sunnhemp into the kraals as fast as the cattle can keep it trampled down.

(4) When there is a depth of well trampled sunnhemp of 18 inches in the kraal, move the latter along the headlands and fill again.

(5) After moving a kraal, spread top soil from the field, and wood ashes or lime over the heap.

(6) Build the sunnhemp into heaps 9 feet broad by 3 feet high, by forking in towards the centre line from either side.

Time of Mowing.—It is recommended that the crop should be left to grow two to four weeks beyond the stage when ploughing is usually *begun*, which is about 14 weeks from germination. It is suggested that reaping should commence at 18 to 20 weeks from the date of germination. This will bring the commencement of the reaping to about the end of March, when the sunnhemp is germinated in the middle of November.

The work will therefore normally be done during April, when no more rain usually falls, and the surface soil is dry. This will facilitate the work and avoid damage to the tilth of the soil.

It is known that the woody tissue or lignin of the organic matter is the chief and most stable constituent of the humus formed by its rotting down, either in compost heaps or in the soil, and it follows that the higher the proportion of wood in the original material the greater will be the quantity of humus left after decay has ceased, and the longer will this humus and its effects last in the soil.

McChlery has shown that there is a steady increase in the fibre or woody portion of sunnhemp from 70 days from planting up to 139 days, or approximately 18 weeks, and this probably continues for several weeks more.

Therefore, by delaying cutting the sunnhemp until 18 weeks and onwards, the amount of humus produced by composting it and the persistence of its effects in the soil, will be materially increased. *It is considered that this will prove to be a very important advantage of this system of utilising the sunnhemp crop.*

It is not advisable, for various considerations as shown above, to plough under the sunnhemp at so late a stage of growth, but these objections do not apply to the composting of the crop by the technique advised here, as will be seen later.

Use of Movable Cattle Kraals.—Having mown the sunnhemp, or as soon as a portion has been mown, easily moveable cattle kraals, of a width of 16 feet, and a convenient length, are erected on the headlands of the fields on either side.

The sunnhemp is then gathered by hay sweeps into cocks of a convenient size, and these cocks, several at a time, are drawn by hay drags up to the side of the kraals and dumped. From these dumps the sunnhemp is forked over the side of the kraals and spread over the floor until about 18 inches deep. Cattle are then placed in the kraals, and as fast as they can trample down the sunnhemp under foot it is daily forked over into the kraals.

When the sunnhemp has been trampled down to a depth of about 18 inches, and sufficiently broken up and impregnated with urine and dung, the kraal is then moved along the headland and the process repeated until the whole field of sunnhemp has been dealt with.

The types of implements suggested for this work are illustrated, and instructions for making two of them cheaply on the farm are given in the Appendix.

Subsequent Treatment of Sunnhemp.—As soon as a kraal has been moved, the heap of sunnhemp and dung may be treated thereafter as compost. Soil from the adjoining field is spread over the heap with a little wood ashes or lime, in the amounts advised in Section I.; half the required quantities being used. The heaps are then built up into the standard size of 9 feet broad by 3 to 3½ feet high, by forking in the sunnhemp from either side towards the centre line. Finally the remaining half of the soil and wood ashes or lime are spread over the surface of the heap, which is now left to await the next season's rains.

This first turning of the heap, and the first turn after rain has wetted the heap the following spring, present the only difficulty in the process, and this can be largely solved by the use of manure drag-forks. With these the tightly matted mass can be torn apart, when ordinary garden forks can then be used to finish the work.

It is better if when making the first turn the materials when forked in towards the centre are also moved 6 feet forward at the same time. By working thus the centre portion of the heap is also turned, and this tends to prevent the loss of nitrogen by denitrification which may take place if the centre portion of the heap is left undisturbed in a compacted condition.

Success Depends on the Growth of the Sunnhemp.—It is clear that the economy of composting the sunnhemp crop instead ploughing it in will be dependent to a large extent on the proper growth of the sunnhemp, and to ensure this on soil of low fertility it will be necessary to apply fertiliser to the sunnhemp, and potash may be required as well as phos-

phates. It must be pointed out that this would be necessary under such conditions whether the sunnhemp is ploughed in or composted.

In extreme cases of soil exhaustion legumes such as sunnhemp, velvet beans and cowpeas may not be able to obtain their own supply of nitrogen from the air, although they receive phosphates and potash. This is due to the fact that the legume bacteria are unable to work in conjunction with legumes when the organic matter in the soil is very deficient.

In such circumstances it may be necessary to plough in a grass type of crop grown on a dressing of a somplete fertiliser. A suitable grass crop such as Rhodesian Sudan grass has a stronger root system than most legumes which is better able to forage for food in exhausted soils, and with the aid of fertilisers will be able to make sufficient top-growth which, on ploughing under, will add enough organic matter to the soil to make it possible thereafter for the legume bacteria to again work in conjunction with the legume and supply the latter with nitrogen.

Such a shortage of organic matter in the soil undoubtedly explains some of the cases reported by farmers from time to time of the absence of bacterial nodules on leguminous crops.

Hastening the Process for Dressing of Winter Crops such as Wheat.—If some of the compost is urgently required for winter crops the same year, the sunnhemp can be cut and composted a month or six weeks earlier when, if three turns are given at intervals of ten days to a fortnight (on rainy days if possible) the compost should be ready for applying to the land about two months later. It may be necessary, in order to ensure this, to increase the number of cattle in the kraal or the time they are kept in the kraal, so as to crush the sunnhemp stalks more thoroughly, and to increase the nitrogen and moisture content of the compost by increased quantities of dung and urine.

However, since the sunnhemp itself will have a high content of nitrogen and contain less woody tissue when cut at this stage of growth (12 to 14 weeks) the question of the rapidity with which it will rot will be largely dependent on

the rainfall during March, the extent to which the sunnhemp is crushed by the oxen, and the frequency of turning the heaps.

It will be best, for this purpose, to leave the sunnhemp undisturbed after moving the kraal until a good shower has fallen, since the wide shallow heap will ensure much more rapid and thorough wetting of the heap by the rain.

Hastening the manufacture of the compost in this way is, of course, wasteful, since a reduced quantity of humus is obtained, and this humus will not last so long in the soil. It is also wasteful of the dung and urine. It may be justified, however, where the compost is applied to irrigated crops.

Economy of Land on Small Farms.—On the smaller farms where economy of land is of particular importance, the composting of the green-manure crop will be of particular value, since only one-sixth or one-eighth of the land need then be idle under green-manure instead of a third or a quarter.

For the same reason, on small farms, at the first turn of the heap after moving the kraals, the inner half may be folded over on to the outer half. This will mean that a strip of land only 9 feet wide will be occupied by the compost heaps, but the amount of hand labour will, of course, be slightly increased.

Alternative System of Composting Sunnhemp.—An alternative system which could be employed is to keep the normal proportion of land under sunnhemp. In the example already considered two hundred out of six hundred acres would be composted, and the compost applied to another two hundred acres of land. In this way two-thirds of the land, or in this case 400 acres out of 600 acres, would receive a dressing of organic manure each year—every acre growing crops, in fact.

By adopting this system the humus content of the soil could be more rapidly built up to the economic level, and a change over to the other system be made after, say, two or three years.

This system might be more suitable for a farm which has been badly overworked and the soil denuded of humus. In such a case the sunnhemp would possibly require fertiliser

to ensure a good crop. It is not considered, however, that this system would be so profitable for normal use as the other, owing to the larger proportion of unproductive land under sunnhemp each year. The writer, nevertheless, reserves the right to change his mind on this point, since there is a possibility that the higher humus content of the soil, which should be maintained by this system might, by giving higher yields per acre, more than counter-balance the disadvantage of having a smaller area under crops each year.

Sunnhemp Compost or Kraal Manure for Vlei Wheat.—The writer has already urged the wheat farmers growing wheat on the sandy vleis of the Colony to grow sunnhemp on their dry lands during summer for conversion into compost, or kraal manure.

The simplicity, economy, and great value of this have been proved conclusively by several farmers.

It has been found possible to cut sunnhemp and convert it into well rotted kraal manure of very high quality in time to apply to wheat the same year.

It may interest wheat farmers to know that 14 acres of wheat dressed with sunnhemp kraal manure in 1936 gave an average yield of 13 bags per acre. No fertiliser was applied.

So simple, inexpensive, and effective is this system of manufacturing the vlei wheat-grower's chief need, namely, organic manure, that it is again strongly urged that wheat farmers, particularly on the sandy vlei lands of the Colony, should adopt it without delay and grow sunnhemp on their dry lands for turning into compost or manure.

The writer is at a loss to understand why this system has not already been widely adopted. The only objection to it so far raised by farmers, of which he is aware, is that sunnhemp will not grow on their dry lands without fertiliser. If this is true, then farmers are strongly advised to apply a dressing of 130 lb. of rock phosphate and 20 lbs. of muriate of potash per acre to the soil before sowing the sunnhemp. The cash price of this f.o.r. Salisbury is 9s. per acre. Only half the acreage of the wet land under wheat need be sown to sunnhemp (on the dry lands), since one acre of sunnhemp should

yield at least 6 to 8 tons of manure, the effect of which should last for at least two years in wet vlei soil, since the soil conditions in these wet vleis lead to much slower destruction of humus than on dry well-drained soils, owing to the lower temperatures and the water-logged conditions.

If the sunnhemp is grown in the second year on the first year's stubble this, with the residue of fertiliser, will give a second good crop of sunnhemp.

Therefore the cost of the fertiliser f.o.r. Salisbury per acre of wheat to which the sunnhemp manure is applied would be a quarter of 9s. per acre per annum, or 2s. 3d.

The cost of the sunnhemp seed at 33 lbs. per acre (Somerset variety), if grown on the farm, should not exceed 1s. 6d. per acre of *wheat* grown.

For this outlay of 3s. 9d. per acre of wheat grown, plus the cost of carriage on the fertiliser to the farm, should give an increased yield of wheat of at least fifty per cent., and probably 100 per cent., or more. Therefore even where the average yield of wheat per acre is only 2 bags, a handsome profit is assured.

Use of Compost on Winter Crops.—A Warning.—A word of warning is necessary here with regard to the application of compost, however made, to winter-grown crops. It is particularly necessary to ensure that the compost is thoroughly rotted before ploughing it in. If rotting is not complete there is a danger of nitrogen starvation of the crops whilst the rotting process is completed in the soil. One farmer has unfortunately experienced this ill-effect on his wheat crop in the 1938 season. It is probable that this is due to the low soil temperatures obtaining during the winter on irrigated or moisture-retaining soil, and the lack of opportunity to aerate the soil by cultivation in the case of cereal crops. These conditions reduce the activity of the nitrifying bacteria i the soil.

There is not the same danger in connection with the growing of irrigated potatoes which receive the usual heavy dressing of 600 to 800 lbs. per acre of complete fertiliser, since the nitrogen in the fertiliser tends to correct the tem-

porary nitrogen shortage in the soil. It may be mentioned in this connection that the farmer just mentioned who experienced the ill-effect of unripe compost on his wheat, found nothing but good effects where the same compost was applied to his irrigated potatoes, which received also a heavy dressing of double potato fertiliser.

Nevertheless, it is advisable to apply only ripe compost to the potato crop, since this will ensure that they are not checked in their early growth.

Sunflower instead of Sunnhemp.—Sunflowers can be used instead of sunnhemp, but the latter is advised wherever possible. Sunflowers should be seeded at the rate of at least 45 lbs. per acre, and cut when the flowers are just out, or earlier if speed is essential. It is possible that a mixture of the two crops may give better break down of the compost than either of these crops alone. A mixture of munga and sunnhemp may also be used for the same reason.

SECTION IV.

THE MECHANISM OF THE DECAY OF CROP RESIDUES IN THE SOIL AND IN THE COMPOST HEAP AND ITS PRACTICAL APPLICATIONS.

The density of the micro-organic population of the soil is so great that the figures are almost beyond the mental grasp of the average person. For instance, during a period of high activity in a fertile soil one ounce of soil may contain 140,000,000,000 bacteria, besides the other types of micro-organisms, which may amount to another 31,000,000. The weight of the above numbers of bacteria in the top six inches of an acre of soil would approximate to 3.75 tons. They contain approximately 10 per cent. of nitrogen.

Their numbers are constantly fluctuating, depending on the factors affecting their growth; that is the supply of air, moisture and food, the temperature of the soil, the acidity or otherwise of the soil, and the numbers present of their natural enemies which feed on them (the amoebae in the case of bacteria).

Their food supply consists of the plant and animal residues in the soil, and carbon dioxide and mineral salts, such as phosphates and nitrates.

In the compost heap it is certain types of these microbes, which are supplied chiefly by the added soil, which use the crop residues and dung as their food supply, and break the former down during the rotting process.

Plant residues consist chiefly of carbohydrate materials such as celluloses, hemicelluloses, and lignins. The celluloses and hemicelluloses make up the softer tissues of the cell walls of the plant, and the lignins are the chief constituent of the woody or fibrous tissues, and the hardened portion of the cell walls.

The celluloses, and a portion of the hemicelluloses, are easily and rapidly broken down by the fungi and bacteria, which use them as sources of energy and food. Some of the carbon is built up into their body tissues, and the remainder, the greater part, they respire as the gas carbon dioxide.

Microbes have no mouths by which they can feed and have to absorb their food in solution through their "skins." They therefore bring their insoluble food into a soluble form by means of digestive ferments which they excrete. These ferments readily attack the starch and celluloses, and some of the proteins in the plant residues; but the lignins or woody portions are very resistant.

The proteins, in which form the nitrogen in the crop residues chiefly exists, are broken down into simpler nitrogen compounds; part is built up again into the insoluble body protein of the micro-organisms, and part is converted into ammonia. The micro-organisms themselves contain much nitrogen; the bacteria, for instance, contain ten per cent.; and whilst they are alive this nitrogen is temporarily unavailable to crops. When the micro-organisms die on the completion of the rotting, owing to lack of food, and the compost is ploughed into the soil, as soon as the soil becomes moistened other bacteria feed on them and convert the protein in their dead bodies into the soluble (nitrate) form of nitrogen, which is at once available to crops.

Some Practical Considerations.

The Modern Conception of Humus.—The modern conception of humus in its simplest form is that it is largely a combination of plant lignin or woody tissue, and proteins; the latter synthesised by the micro-organisms. It also contains some residual hemicelluloses from the plant materials, and some synthesised by the microbes. It is therefore clear that the greater the proportion of lignin (wood or fibre) in the original crop residues of the compost heap, the greater will be the weight of humus left when rotting is finished.

Another constituent of the humus is a proportion of the hemicelluloss, the celluloses having completely disappeared. These hemicelluloses are not so resistant to further change as the lignin portion of the humus.

Now humus is not a constant, imperishable, substance, it is a stage in the decomposition of the organic matter (crop residues), and when compost is added to the soil the humus undergoes further more or less rapid disintegration, according to the conditions existing in the soil. Some types of lignin, too, are more resistant to further chemical or microbiological change than others. The destruction of humus is a very much slower process, of course, than that of its formation by the decay of organic matter. Its destruction may take several years, whilst its production may only occupy as many months.

Now the more mature is any plant material, such as sunnhemp, the greater is the proportion of lignin or wood and fibre in it, and therefore the greater is the proportion of humus left after composting it, and the longer should the effect of that humus last in the soil.

This is a matter of considerable importance to the farmer who is composting his sunnhemp instead of ploughing it in, since it means that the maturity of the crop when he reaps it will greatly affect both the quantity and lasting power of the humus made from it.

Minimum Nitrogen Content Required by Micro-organisms.—The rapidity of the decomposition of such plant materials in the compost heap is largely regulated by the percentage of nitrogen it contains, or which is added in the form of dung or urine. If the percentage of nitrogen in the plant material

such as sunnhemp is less than 1.7 per cent. of the dry matter, the organisms which decompose it must have an added supply of nitrogen in the form of dung or urine to ensure rapid decomposition. A shortage of nitrogen will slow down the process, though it will still be completed, even though the original materials contain only a small percentage of nitrogen. The reason for this being possible is that the microbes commencing the process cease work and die when the nitrogen supply is exhausted owing to lack of food. Other bacteria then use the nitrogen in their dead tissues as a food supply to enable them to break down more of the carbohydrate material. They in turn die owing to shortage of nitrogen, and other bacteria use the nitrogen in their dead bodies and so on, until all the organic matter has been rotted down.

The nitrogen percentage in any crop falls as the crop matures, and it is therefore evident that the more mature the sunnhemp is at reaping time, when it is composted, the longer will the cattle have to be kept on it to supply the deficiency of nitrogen by their dung and urine.

The farmer can only find this out by experience, but if he commences reaping the sunnhemp at 18 weeks from germination he will not have to keep the cattle on the sunnhemp for an undue length of time.

McChlery found that sunnhemp at 18 weeks from maturity may contain 1.50 to 1.90 per cent. of nitrogen, according to the season in which it was grown; in one case a deficiency, in the other an excess, for rapid decomposition. In one year, 1933-34, it contained 1.5 per cent. of nitrogen at 20 weeks from germination.

In composting the sunnhemp crop by the method suggested above, another factor to be considered in deciding on the length of time to keep the cattle on the sunnhemp in the kraals, is the time it takes the cattle to crush the stems sufficiently.

This question affects not only the rate of decomposition, but also the ease of the subsequent handling of the materials as compost, when turning the heaps. A little experience will soon provide the farmer with this information. It is also important from the point of view of speeding up the rotting

process, since the crushing of the stems assists the fungi and bacteria to make entry rapidly, and exposes a far greater area of surface of the materials for them to work on.

For the reasons outlined above it will be found that unbroken stalks of sunnhemp, sunflower, and maize are very slow to break down in the compost heap, and it is advised that such materials should be placed under cattle to be crushed before being put into the compost heap, or better still, mixed with the sunnhemp where this is being composted on the land instead of being turned under.

SECTION V.

THE PLACE OF COMPOST IN RHODESIAN AGRICULTURE.

Until the middle of last century farmyard manure was practically the only fertiliser employed in Western agriculture.

During the last century Liebig announced his theory that the mineral constituents of plants supplied all that was necessary for their growth. Later the historic work of Lawes and Gilbert at Rothamsted showed that Liebig's view was only partly true, but at the same time it greatly stimulated the use of artificial inorganic fertilisers to such an extent that the benefits to be obtained from organic manures, and the necessity for their use to maintain the humus supply in the soil, came to be in danger of being lost to sight.

Latterly, however, the increase in our knowledge of the functions and properties of humus in the soil, due to the great extension of research directed on this subject, has caused the pendulum of agricultural opinion to swing in the other direction.

The rapid depletion of the organic matter in the soils of the large sub-tropical and tropical areas brought under cultivation by the white races during the last century, and the disastrous effects of this on the physical condition and therefore on the fertility of the soils, has helped to focus the attention of agriculturists and scientists on the great necessity for the proper and regular replenishment of the supply of humus in the soil.

Under the extensive system of agriculture largely adopted in these tropical and sub-tropical areas such as this Colony, the balance of nature has been upset, that is the balance between the natural supply to the soil of humus-forming organic material such as the leaves and root systems of trees and grasses, and its consumption or dissipation by the micro-organic population of the soil. The cultivation of the soil has slowed down the former and greatly speeded up the latter. The rate of consumption of humus in the sub-tropical soils by the micro-organisms concerned is very much greater than in temperate climates owing to the much higher temperatures favouring their activity.

It has been shown by Mohr that above an average temperature of 77.2° F. no accumulation of humus can take place in a well-drained and well-aerated soil. During our summer the soil temperature often exceeds 77° F. in the greater part of the cultivated areas.

This is the explanation of the much more rapid loss of humus from our soils, when under cultivation, than takes place under the temperate conditions of Europe.

The extensive system of agriculture still employed in the Colony has greatly limited the quantity of farm manure made. The use of this, and short and long term pastures, are the chief means employed in European agriculture to maintain the humus supply of the soil, but their employment in this Colony is only possible to a very limited extent, at present.

This urgent problem has been met in a measure by the practice of green-manuring, which fortunately fits our climatic conditions well, owing to the almost complete absence of rain during the period between cropping seasons, which tends to prevent losses of plant food from the green crop after it is ploughed in.

However, green-manuring in Rhodesia suffers from a number of inherent disadvantages as pointed out earlier, and there is a limit to the possibilities of its employment, as already mentioned in detail. The writer is of the opinion that many of these disadvantages can be overcome by composting the top-growth of the green-manure crop, where this is sunnhemp.

The supply of organic manure can also be greatly increased by turning all the residues from the maize, wheat and barley and other crops into compost. Their conversion into kraal manure should be discontinued in favour of composting, since the former process is very wasteful, and also insanitary, both from the point of view of crops and human beings.

It may be mentioned here that compost made from crop residues, chiefly maize wastes, has given remarkable results when applied to the cotton crop in this Colony. *Peat found at Gatooma that an application of five tons (short) per acre of compost gave an increase in the yield of seed cotton of 80 per cent. over the untreated cotton. The untreated cotton yielded 500 lbs. per acre of seed cotton, whilst the cotton receiving 5 tons per acre of compost, yielded 900 lbs. of seed cotton per acre. It seems probable, from the facts published, that one important reason for such striking results being obtained is that the compost materially aided the cotton to resist the effects of the serious drought of five weeks during February and March. Such droughts are always to be expected in this Colony, and the drought resistance which humus in the form of compost can confer on crops when applied to the soil is one of the weightiest arguments for its greater employment in our agriculture.

The amount of compost which can be made is limited by the supply of raw materials, and of animal dung. Besides crop residues, however, there is much raw material not yet utilised in the shape of old veld grass, reeds from the riversides and streams. Also, there is a great quantity of grass cut on the sides of roads each year and wasted. The small awkwardly-shaped valleys in the hills could profitably be planted to a permanent crop such as Napier fodder to increase the supply of organic material and at the same time serve as fodder reserves.

Sunnhemp the Main Source of Cheap Raw Material.—However, the main source of cheap raw material at present

*J. E. Peat. Notes from the Cotton Station, Gatooma, 1937. Rho. Agric. Jour., Oct., 1937.

is the top-growth of the sunnhemp crop, and the composting of this on the lines suggested, simplifies and cheapens the production of compost, by eliminating most of the expense of collection and carting of the raw materials, and most of the hand-labour.

It is perhaps pertinent here, in order to gain some idea of the very great possibilities of the system to estimate its potential advantages to the farming industry as a whole, on the basis of the total area of land annually under green-manure at present.

This is approximately 50,000 acres, and so at least 25,000 acres of this could be released to produce crops each year, which on the basis of the estimates given above should amount to 300,000 bags of maize, if this were the crop planted.

The estimate is based on the supposition, of course, that the whole area is normally sown with sunnhemp and that it is heavy loam soil. This is not so, of course, but it serves to illustrate the possible gain to the farming industry by a change to the system suggested.

Kraal Manure *versus* Compost.

Until the introduction of the modified Indore composting method of producing organic manure or humus with rain as the only source of water supply, the making of kraal or farm-yard manure was the only cheap practicable method of utilising crop residues and waste organic matter, which had found favour in this Colony. The defects of the process were, since there was no suitable alternative, ignored, and its virtues only were extolled. Because of this many farmers have difficulty now in appreciating why the making of kraal manure is condemned as a wasteful and insanitary process, and the making of compost is advised in its place, whenever this is economically possible.

A comparison of kraal manure with compost may be briefly summarised thus:—

Kraal Manure.	Compost.
1. Crop diseases and pests not destroyed, and maize wastes therefore cannot be safely placed in kraals.	1. Destroyed by high temperatures, except, possibly, for certain tobacco diseases.
2. Weed seeds not killed.	2. Weed seeds killed.
3. Losses of nitrogen may exceed 78 per cent. during making and application to soil.	3. Gains of 4 to 26 per cent. of nitrogen made from air, during making; losses during application negligible.
4. Losses of potash may exceed 50 per cent.	4. Losses of potash much reduced.
5. In seasons with cold and wet commencement crops do not respond to kraal manure owing probably to the slow availability of the nitrogen.	5. Plant foods in compost rapidly available, and crops respond to it even in cold and wet seasons such as that of 1937-38.
6. Is very wasteful of animal dung and urine.	6. Dung utilised economically and urine partially.
7. Forms the ideal breeding ground for flies.	7. Flies cannot breed in properly made compost.

Some of the above items require further explanation.

Inefficiency of Kraal Manure in Cold Wet Seasons.—With regard to the inefficiency of kraal manure in seasons when the opening months are wet and cold it has been found in the rotation experiments at the Salisbury Experiment Station that in such seasons maize to which 8 tons of kraal manure per acre has been applied shows practically no response to the treatment. In the present season the maize dressed with kraal manure again shows little or no response to the treatment.

These facts are illustrated in the following table of yields in Rotation F., in which three-quarters of the land is under maize and one-quarter of the land is under Sudan grass reaped for hay.

	Maize plus 8 tons kraal manure per acre.	Maize following maize plus kraal manure.	Rainfall. December.	January.
1924-25	8.65 bags	21.75 bags	13.12 ins.	10.51 ins.
1928-29	10.15 bags	14.55 bags	5.45 ins.	11.50 ins.
1932-33	10.75 bags	9.72 bags	7.30 ins.	9.60 ins.
1934-35	6.99 bags	6.05 bags	7.66 ins.	9.60 ins.
Average yields	9.13 bags	13.01 bags		

The yields of maize are given in bags of 200 lbs. each per acre.

It will be seen that in these four years the maize, following maize which received 8 tons of kraal manure the previous year, has yielded on the average about 4 bags per acre more than the maize which received a dressing of 8 tons of manure per acre.

Whatever may be the reasons for the ineffectiveness of the kraal manure in seasons in which the first two months are wet and cold, the fact that it may be largely wasted in four seasons out of 10, as shown by the results obtained on the Salisbury Experiment Station during the last 10 years, is a matter of great importance to the practical farmer, and a strong argument in favour of a change to composting as the method of humus manufacture.

It is probable that this failure of kraal manure in seasons having a cold wet opening is due to the fact that the nitrifying bacteria in the soil are unable under the cold and wet conditions to convert the organic nitrogen into the mineral, soluble form, in which form only is it available to the maize crop.

At the same time these wet cold conditions are also unfavourable to the activity of the free-living nitrogen fixing bacteria, which fix the nitrogen from the air, and so the crop cannot get its immediate requirements of nitrogen from this alternative source.

Loss of Nitrogen.—With regard to the losses of nitrogen during the making and application of kraal manure, it has

been shown by research in England* and on the Continent† that even where the best methods of making and storing under cover are used that the loss of total nitrogen from bullock manure may exceed 78.3 per cent. When the dung was removed from deep covered stalls about 15 per cent. of the total nitrogen had already been lost. After storing in a heap under cover a further loss of up to 42 per cent. of the remaining nitrogen was lost. During exposure of the manure on the field for four days prior to ploughing it under a further 52 to 60 per cent. of the remaining nitrogen was lost.

In a field test of the manurial value of manure applied to oats, barley and turnips, it was found that "in the first year of application dung exposed for four days before being turned in was equivalent to half the same weight of manure ploughed in at once." This is largely due to the loss of nitrogen in gaseous forms.

It is interesting to speculate on how much greater these losses of nitrogen are from kraal manure made under the usual Rhodesian conditions, which could hardly be worse.

On the other hand Howard and Wad showed that during the making of Indore compost, gains of nitrogen from the air amounting to from 4.4 up to 26.3 per cent. may be made.

During storage in heaps for one month they found the losses of total nitrogen amounted to only 0.04%.

There is much evidence of the slow availability of the nitrogen in farmyard manure even under favourable conditions, and under the unfavourable conditions of long continued spells of wet weather it appears that this nitrogen never becomes available to the maize crop in time to be of use, since it must be remembered that annual crops require nitrogen chiefly in the early stages of growth.

*Technical Communication No. 33 of the Imperial Bureau of Soil Science. 1935 pp. 7 to 10.

†Journal of Ministry of Agriculture, Vol. XLII., No. 12: 1936, p. 1231.

Howard and Wad* have shown that the nitrogen in Indore compost is readily available, and the writer has seen convincing evidence in the field this season† that it is readily available even under the continuous wet and cold conditions which obtained in the first two months of the growing season. Maize to which compost had been applied exhibited the normal response to nitrogen shown by the vigorous dark green growth of stems and leaves.

Waste of Dung and Urine.—In the making of kraal manure or farmyard manure, much more dung and urine are employed than are actually necessary to supply the minimum quantity of nitrogen to enable the fungi and bacteria to bring about the decay of the bedding and the crop wastes. This excess of nitrogen is almost entirely lost in gaseous forms, or is leached out by rain as nitrate. If this wasted nitrogen were properly employed in the rotting down of more crop wastes, bedding, etc., by making compost, this loss could be avoided, and much greater quantities of humus could be made on the farm for building up and maintaining the fertility of the soil. Until the introduction into this Colony of the Indore method of composting organic matter it was not possible to utilise safely the great quantities of maize wastes available each year, owing to the danger of spreading diseases and pests by converting them into kraal manure. This tremendous waste of most valuable humus-forming material may now be safely utilised in the making of compost, and at the same time much of the huge loss of nitrogen and other plant foods from the cattle kraals of the Colony prevented.

Destruction of Flies.—As is well known flies are one of the most important agents in carrying bacteria, and to the dairy farmer in particular they form a constant source of infection of his milk and cream, and in consequence are a constant and serious threat to the quality of these products.

Few dairy farmers require reminding of this fact, but they may not all realise that this source of loss can be largely avoided by eliminating the insanitary kraal and manure heap in favour of the compost heap.

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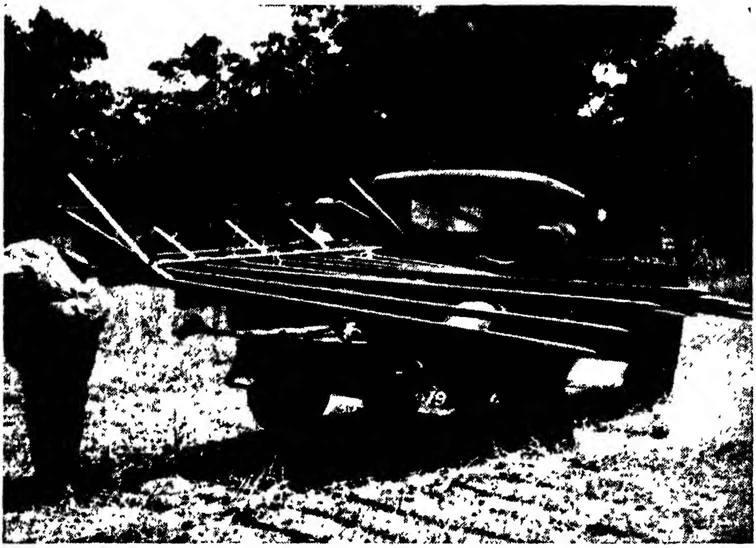
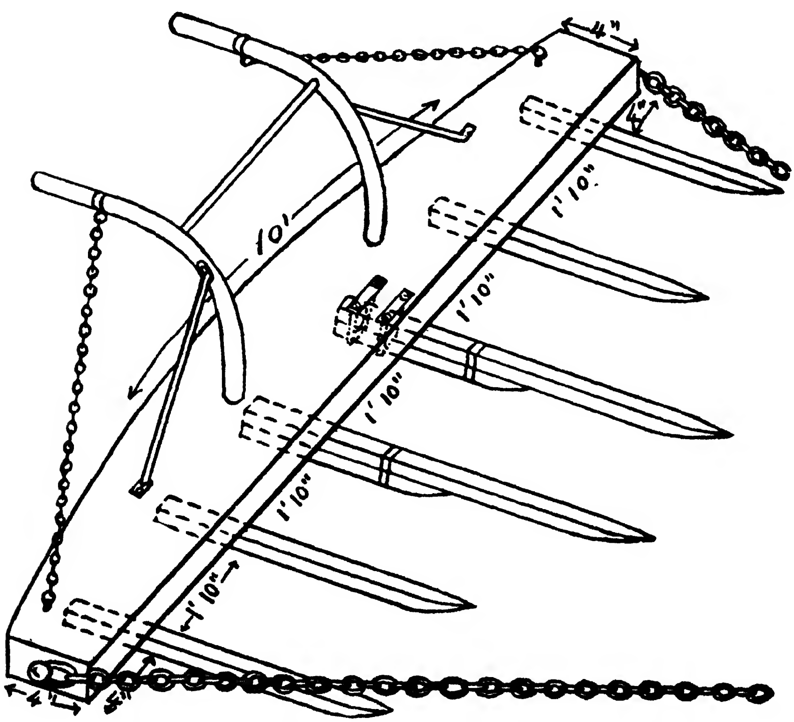
*The Waste Products of Agriculture: Howard and Wad.

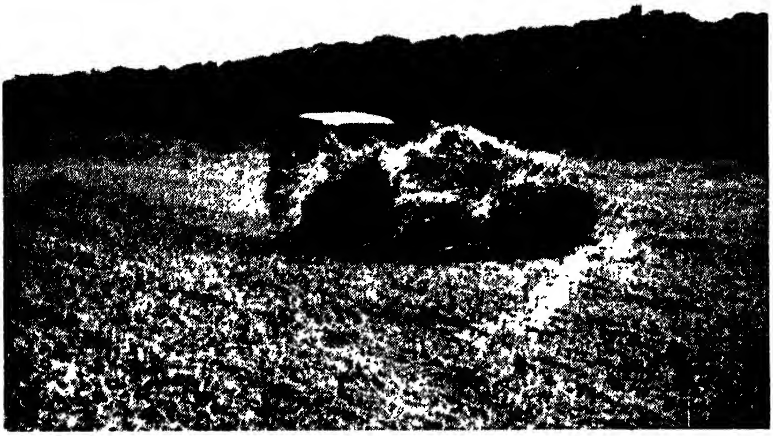
†1938-39.



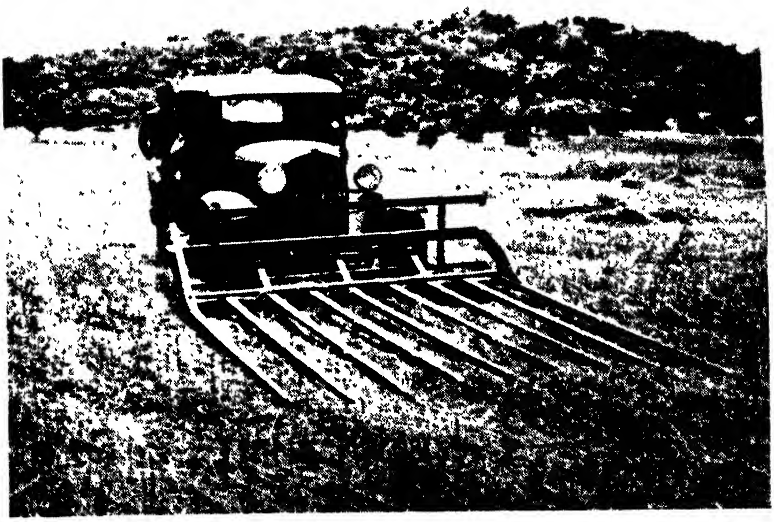
The Sweep is easily removed in a few minutes for transport to another field. Note shape of points, which are metal covered.



Home-made Hay Sweep. (From "Farmers' Weekly.")



The Hosier Hay Sweep in action on Mr. A. S. Laurie's farm at Concession. A full load of sunnhemp being pushed to the loading point



The Hosier Hay Sweep. It is attached to the dumb irons of the lorry

Cattle kraals and manure heaps are the chief breeding places for flies, but these pests cannot breed in properly managed compost heaps owing to the high temperatures of the interior. It is necessary, however, to turn the heaps sufficiently frequently to ensure that any eggs and larvae present in the cooler surface of the heaps are killed by placing the outer layers of the heap in the centre whilst turning.

Flies are also a source of loss to the farmer in that they seriously interfere with the peace and comfort of farm animals, and an animal which is not comfortable can never yield the maximum profit to the owner. It is also necessary here to point out once again that flies are one of the chief carriers of human diseases, though it is hoped that no one is now unaware of this very serious aspect of the fly nuisance.

APPENDIX.

LABOUR-SAVING IMPLEMENTS FOR COMPOSTING.

A description of two types of hay sweep, and a hay drag, which will simplify and cheapen the collection of raw materials for composting, particularly when the sunnhemp crop is composted, is given below.

The Hosier Hay Sweep.—This implement was invented by Mr. A. J. Hosier, the pioneer of the open air milking system, and is being increasingly used by farmers in Great Britain, where it has been most successful.

The writer introduced this implement to the notice of Mr. A. S. Laurie, of Concession, who immediately appreciated its possibilities, imported one, and with his usual public spirit arranged a demonstration of its working on his farm Somerset. Unfortunately very few farmers took advantage of this opportunity to see it in action, but it clearly proved its suitability to Rhodesian conditions.

On an earlier occasion Mr. Laurie kindly gave a demonstration to the writer of its ability to sweep up a crop of sunnhemp hay, which was lying in windrows, and the accompanying photographs show it in action on this occasion. The sweep was attached to an old Ford half-ton lorry and it moved over the uneven ground and along the sides of contour ridges without difficulty and swept the sunnhemp into large loading dumps at a remarkable speed.

The writer was greatly impressed with the work done by this implement, and he can strongly recommend it for use on ordinary farm fields in this Colony in sweeping grass and sunnhemp for composting or, of course, for hay.

With regard to its capacity Mr. Laurie writes as follows: "As regards work done: In three and a half days of easy going the sweep easily cleaned up 60 acres of land. Ten boys were building stacks and simply could not keep pace with it, and so it had to stand still much of the time."

"I am very pleased with the work done by the sweep (much of it on rough going); it saved endless time and labour, and my anxieties regarding sufficient winter fodder for live-stock in future are a thing of the past, *and I should think for making compost it will prove just the very thing for collecting the material where and when required. No more ploughing under of sunnhemp in future, I am thinking.*"

The sweep is made in the following sizes and prices in England. The manufacturers are Messrs. Hosier Inventions, Ltd., Wexcombe, Marlborough, Wilts.

7 tines (6 feet wide) for light cars..... .... price	£5	15	0
9 tines (8 feet wide for 16 h.p. cars...... .... price	£6	10	0
11 tines (10 feet wide) for cars over 16 h.p., price	£7	10	0

The handling and forwarding charges from Beira to Concession amounted to £1 3s. 0d. Spare tines cost 5s. 6d. each, and it is advisable to have some on hand.

Mr. Laurie's sweep is a 9 tine model, but he thinks that possibly a 7 tine model might be more economical under local conditions, since it would probably allow the car to be driven on a higher gear.

Not only does this sweep go far to solve the problem of economically collecting the sunnhemp crop for composting, but it should enable farmers to make better quality veld hay owing to earlier cutting being made possible when the grass has a higher feeding value, owing to the fact that advantage can be taken of short dry spells during the months of January and February.

A Home-made Ox-drawn Hay Sweep.—This type of hay sweep was illustrated in the *Farmers' Weekly* of 17th February, 1937, and the instructions for making it were given by Mr. C. J. Littleton and are quoted below. Many of these sweeps are now in regular use in the Colony and are proving very valuable labour-savers.

With two oxen and four natives it has collected 36 acres of a good crop of veld hay into cocks in two and a half days.

Since this sweep can be made on any farm it may appeal to many farmers, and Mr. Littleton's instructions for making it are as follows. (See illustration.)

"It is made of a stout plank 10 feet or 12 feet long and 9 inches wide in the centre, tapering to 4 inches at each end, with 6 wooden teeth; the two centre ones 4 ft. 6 ins. and the outside ones 3 feet long. These are pointed and shaped as shown, so as to keep them from running into the ground. There are two handles of a half moon shape with a light chain from each handle to the end of the plank to steady the load when full.

The draught is from the ends where the light chains are attached, swivel fashion, and brought to a point where the trek chain is hooked on. The chains must be fairly long to allow for the hay banking up on the sweep, and to allow the latter to turn head over heels when emptying the load.

The teeth are fastened to the plank, as indicated, by means of U-bolts. The two centre teeth are provided with short runners underneath to take the wear, such a sweep will hold approximately half a ton of hay.

To empty the load the team is stopped and backed and the sweep is pulled back about three feet, the handles are then lifted up to stick the teeth in the ground, and the oxen are driven on, and the sweep turns over dropping its load."

A well made sweep of this type is sold in Salisbury at £5 0s. 0d.

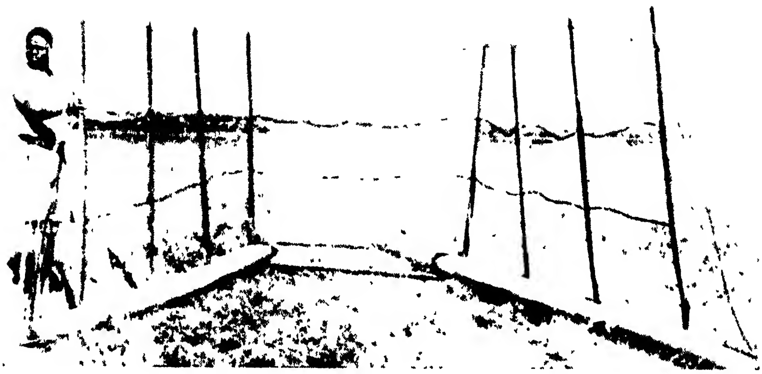
A Hay Drag.—A simple, inexpensive, but efficient hay drag as illustrated and described in the following notes was found extremely useful at the Gwebi Government Farm when the veld hay was stacked in the same field where it was cut.

The hay was cocked in the field, and three or four of these cocks were then collected by the hay drag and drawn to the stack-side, where a derrick fitted with scissor pincers lifted the hay up on to the stack. This method of handling the hay saved a great deal of the labour and time normally employed in loading the hay on to wagons and pitching it from the wagons to the stack, and it serves the same purposes in composting sunnhemp or veld grass.

The drag consists of two wooden poles 6 to 8 inches in diameter and 12 to 14 feet long, hinged at the rear by $\frac{3}{4}$ inch bolts to two parallel iron bars 3 feet by $\frac{3}{4}$ inch thick, and about 2 inches wide. The iron bars are bolted one above the ends of the poles and one below, the bolts passing through the iron bars and the poles. In four holes, evenly spaced along each of the poles, fencing standards of angle iron are fixed by wooden wedges. The implement is completed by three strands of barbed wire running through the holes in the fencing standards. The topmost wire of the three is carried down to the front end of each pole, and so serves as a stay wire to take the strain when a load is being moved. At the draught end of each pole an iron loop is bolted, to which the trek chains are fastened. A span of four oxen is hitched on to each beam; a leader is required for each span and one driver for the two, and an extra boy behind the drag. The latter is required to assist in guiding the drag on to the hay cocks; clearing it of hay at the stack-side; and in steadying the drag when reversing.

When picking up a load, the two teams of oxen are driven up to a hay cock and pass on either side of it, so that the latter is enclosed by the arms of the drag. When a full load has been collected it is drawn up to the stack-side and the two teams then reverse outward to either side; the drag turns inside out and the hay is released. At this point the extra boy is required to remove the hay which clings to the sides of the drag and to steady the drag as it reverses. The drag then goes off for another load.

A number of these drags are doing useful work throughout the Colony. They need only cost a few shillings to make.



Hay Drag for collecting cocks of sunnhemp

USEFUL FIGURES.

(1) One cubic yard contains 27 cubic feet.

(2) Two cubic yards of moist ripe compost weigh approximately one ton. Each two yards length of a heap of ripe, moist compost of the standard dimensions, 9 feet wide by 3 feet high, will therefore contain approximately 3 tons of compost.

(3) One grain sack has a capacity of approximately $4\frac{3}{4}$ cubic feet.

(4) Approximately $5\frac{3}{4}$ sacks of ripe moist compost weigh half a ton.

(5) One cubic foot contains approximately $6\frac{1}{4}$ gallons. Therefore $1\frac{1}{2}$ petrol tins contain rather less than one cubic foot.

(6) One acre inch of rain is equivalent to 101.1 long tons of water or 22,650 gallons (approx.).

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AUGUST, 1939

Station.	Altitude (feet).	TEMPERATURES IN STEVENSON SCREEN AT 4 FEET °F. 8.30 a.m. Dry Bulb.	Wet Bulb.	Dew Point.	Vapour Press. Deficit	Maximum.	Minimum.	Max.+Min. ÷ 2.	Absolute. Maximum. Date.	Minimum. Date.	No. of Days. Max. > 85°	Max. < 70°	Min. > 65°	Min. < 40°	Mean of 24 hrs.	PRESSURE MBS. 8.30 a.m. Station Level.	8.30 a.m. 1200 gdm.	Mean of 24 hrs.	Cloud Tenths.	Sunshine hours.
Beitbridge	1,486	63.0	56.2	49	8.0	79.5	51.8	65.6	89.26	39:11	8	3	—	1	65.6	970 6	887.1	967.9	3.3	—
Bindura	3,700	60.7	54.4	49	6.2	76.2	48.6	62.4	86:24	40: 1	1	—	—	—	—	—	—	—	1.9	—
Bulawayo	4,393	58.1	50.7	44	6.8	72.7	47.6	60.1	83:26	40:12	—	9	—	1	59 7	873.1	884.6	871.7	3.2	8.7
Chipinga...	3,685	59.4	54.5	51	4.9	69.4	51.1	60.2	79: 6	44:11	—	13	—	—	—	896.6	885.8	—	4.1	—
Enkeldoorn...	4,808	57.6	51.0	45	5 8	71.4	46.7	59.0	81:26	38:11	—	11	—	1	—	860.8	885.0	—	2.7	—
Fort Victoria	3,571	57.6	52.0	48	5.0	72.8	47.2	60.0	84.23	36:11	—	8	—	4	59.2	899.8	885.5	—	3.3	—
Gwanda...	3,233	60.3	52.3	45	7.6	73 8	48.6	61 2	84:26	36:12	—	10	—	3	—	910.5	885.0	—	2.7	—
Gwelo	4,629	58.4	51.2	45	6.5	71.3	47.7	59.5	81:26	38·11	—	9	—	1	58.5	865.9	884.9	—	2.8	—
Hartley	3,879	59.7	51.9	45	7 5	77.0	46.8	61.9	84:26	38: 1	—	—	—	1	61.1	889.3	884.7	—	1.0	—
Inyanga	5,503	59.4	51.1	44	7.6	65.7	43.3	54.5	77:24	36: 1	—	19	—	5	—	—	—	—	2.1	—
Marandellas	5,453	55.7	50.0	45	4.8	69.1	46.4	57.8	77:24	40·11	—	16	—	—	56.4	—	—	—	2.6	—
Miami	4,090	60.1	54.3	50	5.8	74 5	48.9	61.7	84·24	44: 1	—	2	—	—	60.7	882.4	884.4	—	1.9	—
Mt. Darwin...	3,179	62.3	55.7	51	6.6	77.4	48 3	62.9	87:24	38: 1	1	—	—	2	—	—	—	—	3.5	—
Mount Nuza	6,668	49.8	45.2	41	3.7	56.9	43.6	50.3	70: 7	35·10	—	30	—	4	48.9	804.6	885.7	—	5.7	—
Mtoko...	4,136	60.6	54.0	49	6.3	72.0	51.6	61.8	82:24	45·11	—	10	—	—	—	881.7	885.3	880.1	2.5	—
New Year's Gift ...	2,690	58.7	54.9	52	3.8	74 8	49 6	62.2	84.23	38: 1	—	7	—	1	—	—	—	—	—	7.6
Nuanetsi	1,547	60.5	57.1	54	3.4	79.0	46.4	62.7	90.26	35:11	8	4	—	3	—	968.5	886.3	—	4.3	—
Que Que...	3,999	58.0	51.5	46	6.0	75.9	48.2	62.0	85:26	41:11	—	3	—	—	61.1	885.7	884.9	884.0	2.3	—
Rusape	4,648	58.4	51.8	46	6.0	71 6	44 7	58.2	82·26	37·11	—	11	—	4	57.8	—	—	—	2.4	—
Salisbury	4,831	58.6	51.5	45	6.5	73.0	47.4	60.2	79.25	38 11	—	3	—	2	59.7	859.8	884 9	858.3	2.7	9.4
Sinoia	3,795	59.8	53.7	49	5.8	78 0	43 8	60 9	85·25	35: 2	—	—	—	5	—	—	—	—	1.1	—

AUGUST, 1939 (continued)

Station.	Altitude (feet).	TEMPERATURES IN STEVENSON SCREEN AT 4 FEET °F. 8.30 a.m. Dry Bulb.	Wet Bulb.	Dew Point.	Vapour Press. Deficit	Maximum.	Minimum.	Max.+Min.÷2.	Absolute. Maximum. Date	Minimum. Date	No of Days. Max > 85°	Max. < 70°	Min > 65°	Min < 40°	Mean of 24 hrs.	PRESSURE MBS. 8.30 a.m. Station Level.	8.30 a m 1200 gdm.	Mean of 24 hrs	Cloud Tenths.	Sunshine hours.
Stapleford	5,304	53.5	50 1	47	3.0	62.3	41 5	51 9	73:24	31· 1	—	26	—	14	—	—	—	—	4.8	—
Umtali	3,672	59.9	55 1	51	4 9	72.5	51.4	62.0	84 7	43 1	—	11	—	—	60.5	897.3	886.1	—	4.4	—
Wankie	2,569	63.8	54.4	46	9 4	85.1	55.7	70.4	93:27	46: 1	18	1	1	—	—	931.1	883.9	—	1.0	—
Abercorn	5,458	60.9	54.3	49	6 3	78.8	54.6	66.7	84 .v.	51· 4	—	—	—	—	—	839.2	882.8	—	2.9	—
Broken Hill ...	3,911	61.6	55 7	51	6.0	78.1	53.4	65 7	87 .24	47. 1	2	2	—	—	65.1	886.9	883.1	—	2.7	—
Chileka	2,600	66.1	59 0	55	7.6	77.8	57.6	67.7	87:24	50· 4	3	2	—	—	—	932.6	885.9	—	3.8	—
Fort Jameson. . .	3,815	65 7	57.4	51	8.5	77.7	57 7	67 7	85·v.	52·v.	—	2	1	—	67 0	890.9	884.5	894.2	1.7	7.4
Fort Roseberry .	3,830	62.1	55.9	51	6 1	81 3	49 7	65 5	98·30	44 20	8	—	—	—	—	—	—	—	—	—
Kasempa... ..	4,500	59.1	53 6	49	5 3	80 8	48.7	64 7	88 26	34 1	5	—	—	1	—	—	—	—	—	—
Livingstone... .. .	3,051	58.2	51.9	46	6 0	81 2	51 0	66 1	89·27	41 1	7	1	—	--	66.1	914 5	883.0	912.9	2.3	—
Loangwa Bridge . .	1,330	66 1	59 0	55	7.5	87 5	58 4	72 9	95 24	51 1	22	—	1	—	73.2	—	—	—	—	—
Lundazi	3,590	65.8	58.6	54	7.5	78 3	46 5	62.4	87 27	40 1	1	—	—	—	62 1	—	—	—	1 9	—
Lusaka	4,193	62 9	54.2	47	8.6	76.3	53 3	64.8	84 26	48· 1	—	2	—	—	63.8	877.9	883.2	876 4	3.3	8.9
Mankoya	3,670	57.1	50.9	46	5.5	82 2	48.2	65.2	89·23	36: 2	5	—	—	2	65.6	—	—	—	—	—
Mongu ..	3,481	62 5	53.1	45	9.0	84.7	55 1	69 9	93·27	49·24	15	—	2	—	—	899.2	882.0	—	2.1	—
Mpika	4,620	61.9	55.4	50	6.5	75 1	53.5	64 3	84 25	45: 1	-	2	—	—	62 8	864.9	883 5	—	2 9	—
Msoro	3,000	68 9	59 9	54	10.0	85 8	55 0	70 4	93 25	46· 1	16	—	—	—	70.5	—	—	—	—	—
Mumbwa	3,500	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Mwinilunga... ...	4,450	58.5	54 8	52	3 6	82 5	50 2	66.3	89 25	40· 1	7	—	—	—	—	—	—	—	—	—
Ndola	4,190	60.4	53 9	49	6 3	80.4	51 4	65.9	88 25	44: 1	5	—	—	—	—	877.7	882.7	—	2.2	—

SEPTEMBER, 1939

Station.	Altitude (feet).	TEMPERATURES IN STEVENSON SCREEN AT 4 FEET °F. 8.30 a.m. Dry Bulb.	Wet Bulb.	Dew Point.	Vapour Press. Deficit	Maximum.	Minimum.	Max.+Min. ÷2.	Absolute. Maximum. Date.	Minimum. Date.	No. of Days. Max. > 85°	Max. < 70°	Min > 65°	Min. < 40°	Mean of 24 hrs.	PRESSURE MBS. 8.30 a.m. Station Level.	8.30 a.m 1200 gdm.	Mean of 24 hrs	Cloud Tenths.	Sunshine hours.
Beitbridge	1,486	65.7	58.6	54	7.6	80.0	55.8	67.9	93:30	62:17	7	2	2	—	67.5	968.9	885.8	966.3	4.8	—
Bindura	3,700	65.2	56.9	51	8.5	80 4	53.4	66.9	92·10	45:19	8	2	—	—	—	—	—	—	2.3	—
Bulawayo	4,393	61.4	52.8	45	8.2	76.1	49.7	62.9	89· 9	40:21	6	5	—	—	62.6	872.1	883.7	868.2	3.1	8.9
Chipinga...	3,685	61.8	56.7	53	5.2	71.7	53.2	62.5	87·10	44:18	1	12	—	—	—	895.3	884.6	—	4.3	—
Enkeldoorn...	4,808	61.2	53.4	47	7.6	76.6	50.9	63.7	88: 9	40:19	2	7	—	—	—	859.9	884.0	—	2.8	—
Fort Victoria	3,571	61.9	55.2	50	6.6	76.4	49.8	63.1	92: 9	40:19	5	7	—	—	62.4	898.7	884.4	896.3	3.3	—
Gwanda...	3,233	63.7	55.2	49	8.5	77.5	52.0	64.8	93: 9	40: 1	5	5	—	—	—	909.2	884.0	874.1	3.5	—
Gwelo	4,629	61.3	54.2	49	7.0	74.9	51.2	63.1	86. 9	39:20	1	6	—	1	61.9	864.9	883.7	—	2.8	—
Hartley	3,879	65.2	56.8	51	8.6	80.1	51.5	65.8	90: 9	42·v.	7	3	—	—	65.7	888.3	883.7	—	2.0	—
Inyanga	5,503	61.9	52.8	45	8.9	71.4	48.1	59.8	84·10	37·23	—	11	—	3	—	—	—	—	3.0	—
Marandellas	5,453	59.4	51.8	45	7.0	72.3	49.5	60 9	81: 9	39:19	—	9	—	1	59.6	—	—	—	2.3	—
Miami	4,090	65.3	56.3	50	9.2	78.4	52.6	65.5	88·10	42 23	1	2	—	—	65.6	881.6	883.6	879.6	3.0	—
Mt. Darwin...	3,179	67.6	59.7	54	8.6	81.0	54.1	67.5	93:10	44: 1	10	2	—	—	67.0	—	—	—	3.7	—
Mount Nuza	6,668	52.1	47.5	43	3.8	59.8	45.5	52.6	79:10	33:18	—	27	—	6	51.8	804.1	884.7	—	5.7	—
Mtoko...	4,136	64.5	55.7	49	8.9	75.4	54.0	64.7	86.10	45:19	1	7	—	—	—	880.8	884.4	879.0	2.5	—
New Year's Gift ...	2,690	63.8	58.4	54	5.7	78.3	53.0	65.7	92.10	45:v.	4	2	—	—	—	—	—	—	—	7.1
Nuanetsi	1,547	64.9	59.4	56	6.0	80.4	51.1	65.8	94·30	40: 1	10	3	—	—	—	968.1	885.3	—	5.0	—
Que Que...	3,999	63.0	55.5	50	7 5	79.5	52.2	65.9	90· 9	43.20	6	3	—	—	65.0	884.8	884.0	882.9	2.4	—
Rusape	4,648	62.0	53.6	47	8.0	74.3	48.8	61.6	86:10	38·19	1	8	—	3	61.1	—	—	—	3.0	—
Salisbury	4,831	62.5	53.5	46	8.7	76.6	50.2	63.4	85· 9	40·19	—	2	—	—	63 1	858.9	883.9	857.2	2.4	9.2
Sinoia	3,795	66.0	57.4	51	9.0	81.0	48.3	64.6	89: 9	38:21	7	2	—	3	—	—	—	—	2.2	—

SEPTEMBER, 1939 (continued)

Station.	Altitude (feet).	TEMPERATURES IN STEVENSON SCREEN AT 4 FEET °F. 8.30 a.m. Dry Bulb.	Wet Bulb.	Dew Point.	Vapour Press. Deficit	Maximum.	Minimum.	Max.+Min —2	Absolute. Maximum. Date.	Absolute. Minimum. Date.	No of Days Max > 85°	Max. < 70°	Min. > 65°	Min. < 40°	Mean of 24 hrs.	PRESSURE MBS. 8.30 a m Station Level.	1200 gdm 8 30 a m	Mean of 24 hrs	Cloud Tenths.	Sunshine hours.
Stapleford	5,304	57.5	52.9	49	4 4	65.3	45 1	55.2	83·10	33 21	—	18	—	9	—	—	—	—	4 5	—
Umtali	3,672	63.4	57.3	53	6.4	76.2	53.7	65.0	92·10	45·19	3	7	—	—	63 4	896 2	885.1	—	4.0	—
Wankie	2,569	70.7	59.3	52	12.9	90.1	60.5	75.3	100. 9	51 18	24	—	4	—	—	929.6	883.2	—	1.8	—
Abercorn	5,458	65.3	56.3	49	9.5	80.7	57.2	68 9	85 5	52. 2	—	—	—	—	67.4	838.7	882 0	—	3.8	—
Broken Hill	3,911	65.2	57.7	52.4	7.9	82.1	56.5	69.3	91: 9	46· 4	12	2	1	—	68.7	886 3	882 5	—	3.1	—
Chileka	2,600	69.4	61.1	57	9 5	81.7	60.2	71 0	93· 9	52.18	9	3	4	—	70.6	931 5	885 2	—	3 5	—
Fort Jameson. ...	3,815	69.1	58.2	50	11 9	81.7	61.7	71 7	91 v	51:v.	8	2	12	—	70.6	890.1	883 8	881.5	1 3	—
Fort Roseberry ..	3,830	68.4	58.1	51	11.4	85 2	"5.9	70.6	98 30	50 v	17	—	1	—	69.6	—	—	—	—	—
Kasempa	4,500	63 1	55.9	50	7.3	83 0	52 4	67 7	90 8	39 21	13	1	—	1	—	—	—	—	—	—
Livingstone	3,051	66.7	56.4	48	10 9	85.7	55.9	70.8	97 9	49 18	16	1	—	—	70 6	910 1	882 4	907.7	2.5	—
Loangwa Bridge ..	1,330	72.6	60.8	53	13 8	92 5	63 2	77 8	102·10	52 21	27	—	11	--	77.5	—	—	—	--	—
Lundazi	3,590	69.0	61 7	57	8.3	82.3	52 6	67 5	92 10	46 4	10	2	—	—	67.1	–	—	—	1.7	—
Lusaka	4,193	66 4	55 4	46	11.4	80 3	56 5	68 4	90 9	48· 1	8	2	—	—	67.6	877 0	882.2	875 3	2 5	—
Mankoya	3,670	65.8	56 0	48	10.3	84 4	54 3	69.4	93: 8	46· 2	16	2	1	—	69.7	—	—	—	—	—
Mongu	3,481	68.7	56.5	47	13.0	88 9	58.3	73 6	96. 8	53 21	24	—	2	—	73.5	898 5	881 4	—	1.7	—
Mpika	4,620	65 5	56 3	49	9.5	79.3	55 6	67 5	90 16	48 21	2	2	—	—	66.6	864 4	882 9	--	2 9	—
Msoro	3,000	72.9	61 7	54	13 0	90 2	59 0	74 6	99·10	50 3	25	1	2	—	—	—	—	—	—	—
Mumbwa	3,500	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Mwinilunga	4.450	62.3	57 5	54	5.0	84.2	54 7	69.5	90 8	49·23	16	—	—	—	—	—	—	—	—	—
Ndola	4,190	65 9	56 3	48	10.0	83.4	55 7	69.6	91 8	48 20	16	2	—	—	68.4	877 4	882.4	-	2.4	—

Rhodesia Weather Bureau.

AUGUST, 1939.

PRECIPITATION.

Station	Inches.	Normal.	No. of days.
Beitbridge	Nil	0.07	—
Bindura	Nil	0.03	—
Bulawayo	0.39	0.02	4
Chipinga	2·49	0.53	6
Enkeldoorn	0.63	0.04	1
Fort Victoria	0.38	0.07	2
Gwanda	0.60	0.06	3
Gwelo	0.19	0.07	2
Hartley	0.29	0.04	2
Inyanga	0.05	0.08	1
Marandellas	Nil	0.09	—
Miami	0.10	0.07	1
Mount Darwin	Nil	0.03	—
Mount Nuza	1.20	0.86	10
Mtoko	Nil	0.05	—
New Year's Gift	0·91	0.16	6
Nuanetsi	0.33	0.04	5
Plumtree	0.12	0.06	2
Que Que	0.59	0.01	3
Rusapi	Nil	0.10	—
Salisbury	0.18	0.12	1
Shabani	0.31	0.01	3
Sinoia	0.35	0.04	1
Sipolilo	Nil	0.07	—
Stapleford	1.21	0.58	8

Station.	Inches.	Normal.	No. of days.
Umtali	0.26	0.21	2
Victoria Falls	0.61	Nil	1
Wankie	0.06	Nil	1
Abercorn	0.24	—	1
Balovale	0·26	—	2
Broken Hill	Nil	—	—
Choma	Nil	—	—
Fort Roseberry	Nil	—	—
Isoka	Nil	—	—
Kanchindu	0.32	—	1
Kasama	0.04	—	1
Kasempa	0.03	—	1
Livingstone	0.33	—	2
Lundazi	Nil	—	—
Lusaka	Nil		—
Mankoya	Nil	—	—
Mazabuka	0.05	—	1
Mkushi	Nil	—	—
Mongu	0.02	—	1
Mpika	Nil	—	—
Mporokoso	0.05	—	1
Mwinilunga	0.33	—	2
Namwala	0.01	—	1
Ndola	Nil	—	—
Petauke	Nil	—	—
Senanga	0.04	—	1
Sesheke	0.04	—	2
Shiwa Ngandu	Nil	—	—
Solwezi	0.13	—	1

Rhodesia Weather Bureau.

SEPTEMBER, 1939.

PRECIPITATION.

Station	Inches.	Normal.	No. of days.
Beitbridge	3.03	0.15	4
Bindura	0.08	0.12	1
Bulawayo	0.91	0.17	4
Chipinga	1.58	0.76	8
Enkeldoorn	1.23	0.14	5
Fort Victoria	1.33	0.20	8
Gwanda	1.51	0.14	5
Gwelo	1.45	0.17	6
Hartley	0.45	0.10	5
Inyanga	1.03	0.21	4
Marandellas	0.45	0.26	4
Miami	0.14	0.02	4
Mount Darwin	0.57	0.07	3
Mount Nuza	2.34	0.90	12
Mtoko	—	0.03	—
New Year's Gift	1.08	0.25	6
Nuanetsi	0.99	0.17	6
Plumtree	1.02	0.03	2
Que Que	1.24	0.07	4
Rusapi	0.04	0.17	1
Salisbury	0.24	0.26	2
Shabani	1.55	0.28	6
Sinoia	0.17	0.19	3
Sipolilo	0.15	0.11	3
Stapleford	2.52	0.82	12

Station	Inches.	Normal.	No. of days
Umtali	0.96	0.38	12
Victoria Falls	1.49	0·01	4
Wankie	0.44	0.03	2
Abercorn	Nil		--
Balovale	1.50	-	5
Broken Hill	0.84	--	3
Chitambo	0.23	-	1
Choma	0.82		3
Fort Roseberry	0.30	-	1
Isoka	Nil	--	---
Kasama	0.28		2
Kasempa	0.06	--	1
Livingstone	1.62	--	4
Lundazi	0.22	-	1
Lusaka	0.33		4
Mazabuka	0.30	--	3
Mongu	0.31	-	1
Mpika	Nil	—	—
Mporokoso	2.03	--	4
Mufulira	0.67	--	2
Mwinilunga	2.00	--	8
Ndola	0.26	-	2
Petauke	0.47	-	2
Senanga	0.55	--	2
Sesheke	1.70	--	5
Shiwa Ngandu	0.38	—	1
Solwezi	1.44		5

Southern Rhodesia Veterinary Report.

OCTOBER, 1939.

DISEASES.

African Coast Fever was diagnosed on the farm Westminster Estate, Salisbury native district, and on the farm Sikoto, Charter native district.

TUBERCULIN TEST.

Twenty-one bulls were tested during the month with negative results. Four animals which gave a doubtful reaction last month were re-tested with negative results.

MALLEIN TEST.

Six horses and thirty mules were tested with negative results.

IMPORTATIONS.

From the Union of South Africa: 39 bulls, 1 cow, 5 horses, 30 mules, 1,483 sheep.

From Bechuanaland Protectorate: 331 sheep, 33 goats, 7 pigs.

EXPORTATIONS.

To Union of South Africa: 147 oxen, 4 cows.

To Portuguese East Africa: 19 oxen, 6 cows.

To Northern Rhodesia: 15 bulls, 1 horse.

EXPORTATIONS—MISCELLANEOUS.

To the United Kingdom: Frozen beef quarters, 7,073 (chilled quality); 335 (general quality); tongues, 7,317 lbs.;